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# EDITORIAL

## A DECADE ENDS

### 1928–1938

IN January 1928, we began our duties as Editor of the American Journal of Surgery. Then it was a monthly publication running to about one hundred reading pages each month, with an annual subscription price of six dollars. The circulation was small, and the circulation department was not always averse to carrying non-paying subscribers on its lists.

On that day when we assumed our duties for the first time, we looked through the files—and noted that the manuscripts on hand hardly sufficed to fill a single issue. That night we had a nightmare; we dreamed that we were about to go to press and that no material was available. That situation has ended; in fact the opposite is true today. We have a plethora of manuscripts bulging our files and our schedules of publication must now run months ahead.

After getting the hang of things, Editor and Publishers got together to decide on future policy. The very first policy adopted was the principle which still stands at the head of our Editorial Page—that the American Journal of Surgery would not be the official organ of any surgical group or society. If such organizations wished to send us papers read at their meetings, we should consider them gladly, judge their worth according to the best of our ability, and accept or reject them in alignment with these judgments. Although we have had many offers officially to represent organizations, we have abided by our early rule, and have remained independent.

A long time ago we decided to increase the reading matter offered in the Journal to a minimum of 2,400 pages a year. This necessitated a rise in the annual subscription rate to ten dollars. In addition, we voted not to give premiums in any form or guise as bait for circulation. Readers come to us for intrinsic worth, not because we throw in a barometer, or

an umbrella, or give fifteen numbers for the price of twelve. We feel that we give the subscriber the full value of his subscription fee, and probably more. If the Journal is not worth the price asked, it would be our duty to reduce the price rather than make up the difference by adding a gadget or some more or less "valuable" prize.

In 1928, at the outset of this decade, the boom was rushing onward to its peak. Two years after we took editorial charge, the depression began. We will not go into the hardships of those years. However, we continued to publish our promised quota of reading matter; we continued to use the finest quality of paper and to maintain the excellence of our typographical work. Publisher and Editor determined to stick to standards of quality and to improve the Journal continually—or else shut up shop. That this policy has been appreciated is reflected in our present circulation: the largest of any independent surgical journal in the world. And this circulation is clear, fully paid up, and swollen by not even one "dead head."

During the past ten years we brought out from time to time a special number. Beginning in September 1936, we began the policy of publishing four special numbers each year. Last year there were issues devoted to Gynecology, Anesthesia, Obstetrics, and Minor Surgery. Thus far this year we have published a Symposium on Urology and one on Fractures. The February issue will be devoted to Surgery in Children, while in April we shall publish the fourth symposium, that on Surgery of the Stomach, Gall-Bladder, Liver and Pancreas. For the next year we are arranging numbers on Eye, Ear, Nose and Throat, on Industrial Surgery, on Reconstruction Surgery and on Surgery of the Extremities. Each special number is under the editorship of a nationally known man in the field covered by that issue.

During the past year we have published a serial on *Practical Clinical Gynecology*, which, with this number, draws to a close. The practical and clinical value of Dr. Falk's work has added to the field of usefulness of the American Journal of Surgery. The whole group of installments will be printed together, to appear shortly in book form.

The American Journal of Surgery has become a fixture in the ranks of surgical publications; it is a quality journal which goes to every state in the Union, and to every civilized country in the world.

For all this, the editor can take a little, but not very much, credit. He pats himself on the back because he had the sense to look to others for advice and counsel. To these co-workers, the members of the editorial board, and to many friends scattered throughout the land, should go the credit for making the Journal what it is today. We wish we could call these men out by name. They have taken the time and trouble to write us long letters, offering suggestions, spanking us, hinting concerning this or that move, ever ready to do a real service. They have given precious time to the reading of manuscripts submitted to them, have given us honest criticisms and weighed opinions as to the advisability of publishing particular manuscripts. In our experience it has again proved true that "if you want to get something done, get a busy man to do it." Those already heavily occupied have been readiest to give us willing assistance.

We have made mistakes; who has not? We have let some excellent papers slip through our hands, only to see them published elsewhere; we have published articles and later wondered how we had ever come to accept them in the first place. One author copied word for word a surgical paper which appeared in another publication, submitted it to us as original—and we published it. The truth did not come out for several months. For our errors of commission and omission we are properly contrite, and with sincerity of purpose turn to the new year and the new decade for a better Journal.

During the past ten years we have made hosts of friends through our connection

with the Journal. These friendships have repaid us for time and effort spent at an interesting, but exacting, task. And to those colleagues who have aided us, to the friends who have made days brighter, to the thousands of subscribers who may have found messages of interest and value in our pages, the Publisher and Editor extend their sincere appreciation and thanks. To all of you—health, wealth and contentment during the years of the next decade.

T. S. W.

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# ORIGINAL ARTICLES

## DIAPHRAGMATIC HERNIA—REVIEW OF THE LITERATURE

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AT one time or another, all of the abdominal viscera, except organs situated in the pelvis, have been found above the diaphragm in a hernia. Of surgical importance are the stomach and colon, especially the transverse portion and the small intestine.

### HISTORICAL

Ambroise Paré,[43] in 1610, and Fabricus Hildanus,[25] in 1646, each reported two cases of traumatic diaphragmatic hernia. The first congenital case was reported by Riverius Lazars,[33] in 1689. Kirschbaum reviewed seventeen cases in 1775. Morgagni wrote a monograph on the subject in 1769. Sir Astley Cooper discussed the subject in 1824.

According to John Wood (1888) it was Guthrie who first proposed laparotomy for reducing a diaphragmatic hernia. The first laparotomy for a non-traumatic case appears to have been performed in 1879 by Badenheuer. While Postempski,[46] in 1889, did the first thoracotomy for traumatic hernia, Pierre Duval,[16] in 1913, appears to have been the first to use the combined thoraco-abdominal approach in the repair of a diaphragmatic hernia.

### INCIDENCE OF DIAPHRAGMATIC HERNIA

Diaphragmatic hernia can no longer be considered as a pathological curiosity since Hedbloom[24] (1931) was able to collect 1003 cases which have been reported in the literature since 1900. The diagnostic use of the *x*-ray has been the most valuable aid in the recognition of diaphragmatic hernia. The technique of Gastro-Intestinal *x*-ray study became fairly well standardized in 1908. According to Arnsparger[1] diaphragmatic hernia had not been recognized in life more than ten times previous to 1908. In 1912, Giffin[19] reported 690 cases of diaphragmatic hernia of which only 15 had been recognized clinically. Kienboeck[30] (1915) in a review of the German literature, noted records of only 3 cases of diaphragmatic hernia and one of eventration which had been diagnosed in life and confirmed at necropsy. From 1900 to 1925, only thirty cases of diaphragmatic hernia were clinically recognized at the Mayo Clinic, while from 1925 to 1933, 147 cases were recognized—five times as many in the past eight years than in the previous twenty-four years. Truesdale[56] (1935) collected 303 cases which occurred in infants and children. Of this number, 165 were found at autopsy; 90 by *x*-ray; and 13 at operation. Vannesson,[57] in 1912, reported thirty-four cases of congenital diaphragmatic hernia in the new-born (all discovered at autopsy) Greenwald and Steiner[20] found eighty-two cases of congenital diaphragmatic hernias in children reported from 1912 to 1928.

The reported incidence varies considerably. Rowlands[48] found only two cases in Guys Hospital, London, from 1856 to 1920. Brown,[9] reviewing the records at the Pennsylvania Hospital from 1910 to 1929, found one case; at the Presbyterian Hospital from 1918 to 1929, one case. In 1926, Pancoast and Boles[42] discovered sixteen diaphragmatic hernias among 9,000 gastric cases examined, all but one being non-traumatic. Bowditch[7] reports two cases out of 5,033 clinical examinations at Bellevue Hospital, New York. MacMillan[35] found

but three cases in 15,000 *x*-ray examinations at the U. S. Army General Hospital No. 8. Morrison[37] (L. B.) reports forty-two cases in 3,500 Gastro-Intestinal *x*-ray examinations studied. Carman,[12] in 1924, gave the ratio in the Mayo Clinic as 1:18,000 examinations. Automobile accidents are producing an increased incidence of traumatic hernias.

### SYMPTOMS

It is apparent that since every abdominal organ except the genitalia, bladder, and rectum have been found in the thorax at least once, the symptoms will be varied and inconsistent—depending upon the organs involved. In general they may be divided into (1) thoracic and (2) abdominal. The thoracic symptoms are caused by the encroachment of the herniated viscera on the pleural space with resulting cardiac and respiratory embarrassment evidenced by dyspnea, cyanosis, pain and fullness in the chest, vomiting, etc. The abdominal symptoms are caused by the incarceration of abdominal viscera in the hernial opening, varying from slight irritation to obstruction and strangulation.

Reviewing the histories of patients suffering from chronic diaphragmatic hernia, it is interesting to note the length of time the symptoms have persisted, and the frequency with which the diagnosis of gall-bladder, ulcer, and angina has been made. The patients have more or less symptoms of indigestion, but manage fairly well if they are careful of over-exertion and of the quantity of food they take. The periodic attacks come on suddenly, usually after eating when they are seized with severe epigastric pain, and where the stomach is involved in the hernia, there is nausea, vomiting, a sense of fullness in the chest, associated with dyspnea and cardiac embarrassment. If the bowel is included in the hernia, the symptoms are usually more severe and are associated with signs of intestinal obstruction. After a number of these attacks, the patient learns to resort to self-induced vomiting for relief.

The most common symptoms noted by Giffen[19] were: (1) pain in the epigastrium and chest immediately after eating; (2) paroxyms of smothering without apparent cause, and (3) vomiting without premonition. Healey gives as the principal symptoms: (1) substernal pain; (2) vague gastric distress, and (3) vomiting. The cardinal symptoms given by Oden are: (1) epigastric pain immediately after meals; (2) inability to take quantities of food; (3) a sense of smothering or distress, and (4) inability to belch or vomit during the attack. Harrington[23] (1928) reported epigastric pain as the most constant symptom in the surgical cases at the Mayo Clinic. The other symptoms in the order of frequency were regurgitation of food, vomiting, gastric distress and distension; and distress immediately after eating, hemoptysis, and melena. It is evident that diagnosis by the history alone may be difficult because the vague symptoms simulate diseases of the gall-bladder and stomach most commonly.

### PHYSICAL SIGNS

The physical signs vary according to the side on which the hernia is situated, the extent of the hernia, the amount of displacement of the thoracic organs, the amount of herniation of the abdominal viscera into the pleural cavity, and the state of fullness of the viscera occupying the chest cavity. Thus a case may show signs of pneumothorax at one time, and hydrothorax at another, depending on the amount of fluid present in the displaced bowel when the examination is made.

In 1912, Carson and Huelsman[13] noted five physical signs common in diaphragmatic hernia, viz.: (1) Displacement of the heart; (2) Drawing in of the abdomen; (3) Intestinal noises in the chest; (4) Absence of breath sounds and change in percussion note; (5) Changeable character of signs on change of posture.

### DIAGNOSIS

Truesdale[56] has remarked that in many cases the diagnosis is more difficult than

the operative cure. The readiness with which most cases can be recognized depends upon the presence in them of portions of hollow viscera. *X*-ray is the most important single diagnostic aid. In 1912 Giffin[19] made a thorough review of the literature and was impressed by the infrequency of correct preoperative or antemortem diagnosis. He found that in about 650 cases of diaphragmatic hernias reported, only fifteen were correctly diagnosed during life. Scudder[45] reporting a case in 1912, states that of fifty-three cases in which hernia was found, only six had been properly diagnosed prior to operation.

The symptoms and signs of diaphragmatic hernia are complex, bizarre, and changeable. Obscure chest and upper abdominal symptoms demand *x*-ray examination to rule out diaphragmatic hernia. Respiratory difficulty and recurrent gastro-intestinal obstructive symptoms in infants and children should lead to a suspicion of diaphragmatic hernia. With a history of previous injury, especially crushing injuries to the abdomen or thorax, diaphragmatic hernia should be suspected and ruled out.

### DIFFERENTIAL DIAGNOSIS

Harrington,[23] Hedbloom[24] and others have drawn attention to the frequency with which symptoms of diaphragmatic hernia have been ascribed to gall-bladder disease. In Harrington's sixty operated cases (1933), the preliminary diagnosis was cholecystitis in twenty-nine. Irritation of the phrenic nerve endings must be a constant factor in these cases, and undoubtedly accounts for the many symptoms ascribed to the gall-bladder. Next in frequency was diagnosis of gastric disease (twenty-three times), and when one remembers the great preponderance of hernia through the esophageal hiatus and the high percentage of involvement of the stomach in the hernia, such a mistake is readily understood. In seven, a diagnosis of heart disease was made.

In children the cases are most commonly mistaken for congenital heart disease, since the patient usually has a left sided hernia giving physical findings of dextrocardia with attacks of cyanosis and dyspnea.

The presence of abdominal viscera in the thorax is not infrequently mistaken for tuberculosis and hydropneumothorax. Truesdale,[56] in 1921, operated on a child of 5 who was run over by an automobile nine months previously. The child had spells of dyspnea, cyanosis, and distress after eating. He was examined by many physicians who concluded the child had tuberculosis of the lungs with cavity formation. The left thoracic cavity was found to contain the stomach, small intestines, colon, left lobe of the liver and spleen.

O'Dwyer,[41] in 1889, operated on a child of 3 who had a congenital diaphragmatic hernia. The case had been diagnosed as purulent pleurisy. Thoracotomy was done and a diaphragmatic hernia containing small intestines was found. Giustinian and Antonelli[22] (1931) report a case of an infant 22 months old who was admitted with a diagnosis of bronchitis and pleural congestion with serofibrinous pleurisy. A double pleural puncture at the seventh and eighth intercostal spaces yielded a few drops of serous fluid. *X*-ray, seven days after admission, did not clear up the diagnosis. Autopsy revealed the greater part of the right hemithorax occupied by the small intestines, cecum, appendix, ascending colon and middle part of the transverse colon. Struppler's[53] case had nineteen exploratory punctures before the correct diagnosis was made. Truesdale[56] cites a case in which milk was aspirated from the chest by exploratory puncture. Lebon[34] reports two cases of false pneumothorax, one in a soldier who had the stomach punctured twice by parancentesis thoracis. Likewise, Stivelman,[52] doubting the diagnosis of pneumothorax in a tuberculous patient, administered a barium meal and found the case to be one of eventration.

The opaque meal and Roentgenoscopy should never be omitted after a careful analysis of the history and physical findings make one doubtful of the presence of a hydropneumothorax.

Ball[3] (1935) has suggested having the patient swallow "Seidlitz Powder" to generate gas in the stomach for contrast in fluoroscopic and *x*-ray examination.

### CLASSIFICATION

Numerous classifications based on anatomy, embryology, etiology, and contents have been offered. But, since it is impossible to distinguish these classifications clinically, it is better to consider all as (1) traumatic, and (2) non-traumatic. Non-traumatic may be subdivided into (a) congenital—due to embryonic deficiency and (b) acquired—after birth. Traumatic may be divided into (a) indirect injury—result of crushing blows to chest or abdomen, and (b) direct—result of puncturing wounds following stabbing or shooting.

### TYPE AND LOCATION OF REPORTED CASES OF DIAPHRAGMATIC HERNIA

Woolsey[60] (1927) reviewing 106 cases found that 28 were traumatic; 28 were acquired, and 50 were congenital. Hedbloom[24] (1931) reviewing the 1003 cases reported since 1900 found that one-third were classified as congenital, slightly more than one-third acquired after birth, and one-third as acquired after trauma. Hedbloom also states that in 163 cases operated on since 1907 hernia at the esophageal orifice was found in thirty-three. Pancoast and Boles[42] (1926) state that the majority of diaphragmatic hernias have been on the left side—the ratio to those occurring on the right being 12:1. In the 106 cases studied by Woolsey[60] hernia was at the esophageal orifice in seventeen. Harrington believes that hernia at the esophageal orifice of the diaphragm is the most common type that occurs in adults. Le Wald believes that all cases in which an abdomnal viscus is found in the thoracic cavity should be regarded as congenital, unless there is overwhelming evidence that the condition has been acquired.

### HERNIATED CONTENTS

In the fifty-seven operated cases in children studied by Truesdale[56] most of the gastro-intestinal tract and spleen were the herniated contents in twenty-five. In four the stomach alone, and in four the transverse colon alone; the rest had combinations of the abdominal viscera.

Hedbloom[24] in a review of the 1003 reported since 1900, states that the stomach was found in the hernia in 737; in 69 per cent it was associated with other organs; in 71 per cent the colon and small intestines were found with the other organs. In eleven of fifty-six cases of right sided hernia collected by Hedbloom, the only visceral tissue included in the hernia was a part of the liver.

### ANATOMICAL AND EMBRYOLOGICAL FACTS OF INTEREST

Since imperfections of development are so well recognized in other parts of the body, producing such deformities as harelip, cleft palate, spina bifida, hypospadias, etc., it would be strange if a structure so complicated in its origin as the diaphragm did not frequently fail to develop perfectly, and furthermore, if its fusion were incomplete, the strains to which it is subjected in early life are likely to manifest its weakness. (Harrington.) It is interesting to note that in the fetus, the increased intra-abdominal pressure due to the rapid increase in the size of the liver, and in the length of the midgut, produces a physiological umbilical hernia. Any existing embryological defects in the diaphragm would permit herniation of viscera through the defect in the presence of this increased intra-abdominal pressure.

The closure of the *right* leaf of the diaphragm takes place *before* the left leaf. The right leaf is protected by the liver and assists in its more rapid completion. The stomach reaches its permanent site below the diaphragm before the left half of the

diaphragm is closed. Therefore, any unusual increase in intra-abdominal pressure would force the stomach into the chest. From the above embryological facts, congenital diaphragmatic defects are reported as from ten to eighteen times more frequent in the left leaf than in the right leaf.

Harrington[23] (1933) examined the esophageal hiatus in 500 cases, and found that in 65 per cent of cases the diaphragm was closed snugly around the esophagus; in 35 per cent at least one finger or more could be placed between the esophagus and the margin of the diaphragmatic opening; in 40 per cent two fingers could be inserted and in 5 per cent three fingers.

## TREATMENT

The treatment of cases of diaphragmatic hernia in which the symptoms are mild and there is no obstruction, may be medical. Many patients go through life without sufficient symptoms to warrant operative intervention. In chronic cases with attacks of incarceration or obstruction of the herniated viscera, operation is usually indicated. In acute cases due to penetrating wounds with rupture of a viscus, immediate operation is demanded. In acute cases due to indirect injury of the diaphragm without injury to the viscera, palliative measures are probably preferable until the shock of the injury and the acute symptoms subside. (Harrington.)

Palliative treatment may be given by passing a stomach tube and giving an enema to empty the intestinal tract of gas, thus diminishing the size of the displaced viscera and permitting a return to their normal position. The patient should then be put on a non-constipating and non-fermenting diet.

Attempts at reduction of the hernia and palliative surgical measures such as gastroduodenostomy and gastropexy have been done by Albanese (1904), Bythell (1915), Downes (1918), Willy Meyer (1919), Abodie (1925), Robertson (1929), and Ager (1930).

Hedbloom[24] (1931) believes that a small hernia anywhere except at the esophageal hiatus should be repaired even in the absence of symptoms.

The approach may be thoracic, abdominal or combined. Hedbloom[24] advocates primary laparotomy in all cases of obstruction. He states that it is always indicated in cases of hernia in the esophageal hiatus, and that in cases of fresh penetrating wounds of the thorax thoracotomy is the only approach to be considered.

Truesdale[56] (1935) reporting thirteen operative cases in children used the thoracic approach in ten cases, the abdominal in two, and the combined approach in one. He states that while laparotomy is more direct, requires less time and produces less shock, its application has limitations; that in traumatic and congenital cases in children, adhesions and distended viscera prevent reduction from below.

In the twenty-seven reported successful operations on children in the United States from 1920 to 1935, the abdominal route was used eleven times, the thoracic approach ten times, and the combined six times. In the nine successfully operated foreign cases the abdominal route was used seven times, the thoracic once, and the combined once. Of the reported fifty-seven operations for diaphragmatic hernia in children, the abdominal route was used in thirty-three, the thoracic in fifteen, and the combined in nine.

Hedbloom[24] (1931) collected 476 surgically treated cases and found that laparotomy was done in 215; thoracotomy in 167; combined thoracolaparotomy in 91. Of the series of 215 laparotomies, the hernial opening was sutured in 129, reduced but not sutured in 37, not reduced in 33 and not found in 16. Of the 167 cases in which thoracotomy was done, the opening was sutured in 91, not sutured in 6, not reduced in 3, and not found in 7. Of 91 cases in which thoracolaparotomy was found, the ring was sutured in 81, not sutured in 3, and not found in 7.

Harrington[23] (1933) reporting sixty operated cases at the Mayo Clinic prefers the

abdominal route, and this approach was used in fifty-four of the sixty cases. Here it is interesting to note that whereas there were only nineteen cases operated upon at the Mayo Clinic from 1900 to 1925, sixty were operated upon from 1925–1933.

### PROGNOSIS

From the recorded cases it appears that when the stomach is the only organ involved in the hernia, the patient is likely to tolerate the hernia. Hernias at the esophageal hiatus appear to respond better to surgery as in the cases reported by Greiwe,[21] Pauchet,[44] Harrington,[23] and Hipsley.[26] Greenwald and Steiner,[20] in 1928, reported that of their six patients who died, in only one was the hernia at the esophageal opening; of the five operations that were successful, four were esophageal. Hedbloom,[24] in 1931, collected 476 surgically treated cases. In 246 laparotomy was done with a mortality of 34.9 per cent. In 132 operated upon by thoracotomy the mortality was 19.7 per cent; and in 89 operated by the combined thoracolaparotomy it was 31.4 per cent. Of the 303 cases in infants and children collected by Truesdale,[56] 44 were operated upon; 24 successfully and 20 with fatal termination—a total mortality rate of 45.5 per cent. Truesdale (1935) reports thirteen operations on children personally done with one operative death—a mortality of 7.7 per cent.

Truesdale[56] (1935) reports that from 1920 to 1935 there have been twenty-seven successful operations on children in the U. S., and nine in foreign countries; twelve unsuccessful operations on children in the U. S., and nine unsuccessful in foreign countries. He believes that operation for congenital diaphragmatic hernia in infants and children should be done early, contrary to the opinion now held by general practitioners and pediatricians to delay surgery until adolescence. He states that the contents of a hernia cause disturbances of digestion, respiration, and circulation, leading to undernourishment and underdevelopment.

Harrington[23] (1933) reporting on sixty operative cases at the Mayo Clinic states there was one recurrence and five deaths. Of the fifty-one patients who were subjected to radical operative procedures, all except one obtained relief of symptoms. In a study of 378 cases, Harrington found that the mortality in the presence of obstruction was 60 per cent, but that the mortality of those operated upon before obstruction has in recent years not been higher than that of any other abdominal operation.

Early surgical treatment gives an excellent prognosis. The high mortality so frequently quoted is due to the occurrence of complicating intestinal obstruction and strangulation, and the employment of operative treatment as a last resort.

### TECHNICAL AIDS GATHERED FROM THE LITERATURE

Hedbloom[24] advocated inflating the lung before closure; or aspirating the air after closure to overcome the serious disturbances of intrathoracic pressure relationships. He also advocates preliminary phrenicotomy to relax the diaphragm and facilitate closure of large defects, and as a palliative measure in cases where radical closure is contraindicated.

C. F. Mayo has suggested inserting a tube through the hernial opening into the thorax permitting air to enter the pleural space and reducing the negative pressure in order to facilitate reduction of herniated viscera.

Since emergency operations for diaphragmatic hernia are almost invariably done not for curing the hernia, but for relief of the acute intestinal obstruction, a preliminary appendicostomy or cecostomy should be done to relieve the obstruction, and a secondary operation for the repair of the hernia itself. This procedure will reduce the mortality of surgery in patients with acute obstruction.

Intratracheal anesthesia is found to be advocated to maintain positive pressure. Gastric lavage should be done just before operation, and the tube left in the stomach

not only to relieve the stomach of gas and fluid but to facilitate reduction and help determine the position of the cardia.

Truesdale[56] (1931) injects the phrenic nerve with novocaine to decrease diaphragmatic excursions and to prevent permanent alterations in the structure and function of the diaphragm. Truesdale believes that if paralysis of the diaphragm will facilitate repair, temporary crushing or injection is preferable to permanent paralysis.

## SUMMARY

1. The literature is recording an increasing number of cases of diaphragmatic hernias diagnosed in life, and large series of successfully operated cases.

2. The symptoms and physical signs of diaphragmatic hernia are varied and complex, clinical diagnosis is difficult without *x*-ray examination.

3. Diaphragmatic hernia is frequently mistaken for diseases of the gall-bladder, stomach, heart and lungs.

4. Obscure chest and abdominal symptoms demand *x*-ray of the gastro-intestinal tract as well as of the chest to rule out hernia.

5. Respiratory difficulty and recurrent obstructive symptoms in infants and children should lead to a suspicion of diaphragmatic hernia.

6. Diaphragmatic hernia should be suspected in crushing injuries of the chest and abdomen.

7. The mortality of those operated on before obstruction has occurred, has in recent years not been higher than that of any other abdominal operation.

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"In any patient with a strangulation, in whom the pulse is hurried or the blood pressure is at or near shock level, the transfusion of blood is indicated."

"In the peritoneal cavity, three factors operate to defeat the walling-off process with which the peritoneum strives to combat infection. All have to do with motion, the first two with active movement and the other with passive motion: (1) the activity of the bowel; (2) the excursions of the diaphragm; and (3) the secretion of fluid into the peritoneal cavity."
From—"The Therapeutic Problem in Bowel Obstructions," by Owen H. Wangensteen (Thomas).

# WOUNDS OF THE THORACIC VISCERA*

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AT the meeting of the American Medical Association this year, Dr. D. C. Elkin, of Atlanta, read a paper on "Injuries of the Thoracic Viscera." He reviewed a series of 553 cases including eleven perforating wounds of the heart, with the remarkably low mortality of 6 per cent and with only eight instances of subsequent empyema; 148 of these patients were in shock on admission to the hospital. This extraordinary low mortality and incidence of empyema show what can be attained by thoughtful and proper treatment of these injuries and offer to us all standards we should try to emulate. Except for certain definite indications for operation, his method of procedure is distinctly conservative, its aim being to restore the thoracic viscera to their *normal* status in the shortest possible time with the least possible surgical trauma superimposed on the damage already present.

Intelligent treatment of injuries to the thoracic viscera must depend upon adequate comprehension of the anatomy and physiology of these organs. Let us consider the thorax as comprised of four compartments: the closed pericardial and two pleural sacs, with the loose areolar tissue between them. This last, the mediastinum, contains important nerves; the friable thoracic duct; lymph nodes; and the esophagus and great vessels, which are subject, like the lungs and heart, both to direct trauma and also to displacement and torsion from adjacent lesions. Under normal conditions the pressure in the pleural cavities varies from −9 cm. of water in full inspiration to −3 or −4 cm. in expiration. Due to the thinness of the pleurae, and the mobility and looseness of the mediastalin structures and areolar tissue, any alteration from the normal in one of the pleural cavities immediately results in a similar change in the other two sacs. This indirect effect upon the pericardium is less marked, however, due to its thickness and fixation to the diaphragm. Thus in addition to the treatment for shock, hemorrhage, repair and prevention of infection as far as possible, we must likewise attempt as soon as feasible, first to restore the mechanics of the cardio-respiratory system to their normal state, and then to maintain it. This means a frequent appraisal of the entire thorax both by physical signs and *x*-ray, and prompt action with aspirations or temporary closed drainage to correct any sudden pressure change, which might be fatal if unrecognized or allowed to persist. Major operative intervention should be reserved almost entirely for wounds of the heart, large wounds of the chest wall with or without rib fractures, hemorrhage from an intercostal or internal mammary vessel, and (rarely) for a wound of the lung itself in which a large vessel has been torn and which is not controlled by the ensuing pneumothorax.

The wounds of the chest ordinarily encountered in civil life are contusions or crushing injuries caused by falls and automobiles, or gunshot and stab wounds. In the last category, an ice-pick is a frequent attacking weapon; hence the wound is of the small puncture variety leaving a practically intact chest wall and with a minimum chance for infection or residual

* Read at Graduate Fortnight of the New York Academy of Medicine, October 30, 1936.

foreign body entering the pleura or lung. We rarely see the gaping sucking wound which is so common in war surgery.

### CONTUSIONS

The simplest form of injury is the contusion without rib or sternal fracture. If over the lungs, there may be a resultant pneumonia or pleurisy, either dry or with effusion. If clear fluid develops, the presence or exacerbation of a latent tuberculosis must be borne in mind. There may be a low grade temperature, which, if due to the traumatic pleurisy alone, should subside within a week or ten days. In any event, the patient should be kept in bed until all the fluid has absorbed and the temperature has been normal for a week. In the presence of demonstrable fluid, diagnostic puncture is always indicated. If a clear effusion is found, it is removed only to relieve symptoms of pressure such as dyspnea, tachycardia, and displacement of the heart to the opposite side.

When blood is present, depending upon the severity of the injury and the extent of bleeding the patient may or may not show signs of shock or hemorrhage. If the amount of blood is small it should be left alone. Otherwise it should be removed by aspiration and replaced with air. Extensive hemorrhage may occasionally occur sometimes following violent coughing or strain with the tearing of a vascular adhesion, or following an unusually severe blow, either on the side of trauma or in the contralateral pleural cavity. Three examples of the above may be mentioned: the first, a patient who sustained an hemothorax following a sudden strain or wrench; the second, a man who fell into the East River from Brooklyn Bridge, whose only injury was a hemothorax of such alarming proportions as to require transfusion; the third had a stab wound which just penetrated the pleura on the right, but his chief trouble was a moderate hemothorax in the left chest with a small amount of air also present.

This type of hemothorax is apt to be more troublesome than the hemopneumothorax due to lung injury, because the bleeding is usually from the parietal attachment of the adhesion and tends to persist or recur, often necessitating repeated transfusions. If a suitable donor cannot be obtained, the blood from the pleural cavity may be removed into 0.5 per cent sodium citrate, filtered through gauze, and refused. As mentioned above, as the blood is withdrawn from the pleural cavity it should be replaced with two thirds as much air. This maintains some tamponade on the bleeding point, allows more rapid re-expansion of the lung, and keeps the pleural surfaces free from the organizing fibrin of the blood clot. If hemorrhages persist in spite of this method of therapy, it may be necessary to attack the bleeding point directly either by means of the thoracoscope and cautery or by open operation.

It is generally recognized that contusions of the chest wall may cause a localized atelectasis of the underlying lung with bronchitis or pneumonia, or may activate a quiescent tuberculosis. The best prevention against atelectasis and pneumonia is sufficient sedation to allay pain on respiration and thus prevent too much splinting of the injured chest, but yet not enough to depress respiration; a binder or strapping to effect the same end; change of position; plenty of fluids to prevent viscosity of bronchial secretions; and the encouragement of productive cough if present, with the aid of espectorants as necessary. Great care should be taken to ascertain what, if anything, the patient had in his mouth at the time of the accident to guard against the possibility of an otherwise unsuspected foreign body lodging in the respiratory tree. If there is any doubt at all, careful *x*-ray studies should be made and the help of a competent bronchoscopist obtained.

Contusions of the heart give rise to characteristic symptoms. Such injuries may be accompanied by dyspnea and simple precordial pain and tachycardia or by the more serious manifestations of pericardial effusion, extrasystoles, paroxysmal tachycardia or fibrillation; or by angina

and attacks simulating coronary thrombosis with the presence of a pericardial friction rub. This traumatic syndrome should be given most serious attention, strict bed rest enforced, sedatives liberally prescribed, and electrocardiographic studies made. Consultation with a capable internist should be sought to decide upon the use of any of the cardiac group of drugs as may be indicated and also as to the rigidity and extent of the convalescence. This last will depend partly upon the extent of the injury and partly also upon the age of the patient.

### PLEUROPULMONARY WOUNDS

These injuries are of two sorts: the first group includes those in which the chest wall is intact, the second those in which there is an open wound involving parietes, pleura, and lung. Of the first type, the simplest is the spontaneous pneumothorax with rupture of the lung following cough, a fit of crying in infants, a blow, or an unusual strain. This may be accompanied by almost insignificant symptoms of transitory pain, shortness of breath, palpitation, or a flopping sensation within the chest. On the other hand, symptoms may be precipitated with great violence and quickly become most alarming with or without the development of fluid. Such a fulminating course is caused as a rule by the ball valve type of pneumothorax, in which cases air enters the pleural cavity through the tear in the lung or bronchioli, but cannot escape because of the valve-like mechanism. A high intrapleural pressure is soon built up with marked dyspnea, cyanosis, rapid pulse, tympany over the affected side, and cardiac and mediastinal displacement to the opposite side. This must be promptly and cautiously relieved either by repeated aspirations or by a catheter system of closed drainage—otherwise the patient will die. If the tear in the lung is on its mediastinal surface with involvement of the adjacent mediastinal pleura, subcutaneous emphysema will appear first in the neck along the carotid sheath and then spread all over the body. Rarely this condition may become so marked with signs of persistent increase as to require incision along the carotid sheath low in the neck to provide an escape for the air, as it bubbles up through the loose areolar tissue of the mediastinum.

The commonest etiology for pleuropulmonary injuries with an intact chest wall is fracture of one or more ribs. The only evidence of such injury aside from pain may be a solitary small hemoptysis or a localized area of subcutaneous emphysema about the point of fracture with local tenderness and crepitus. On the other hand there may be extensive subcutaneous emphysema or a large and increasing pneumothorax or hemopneumothorax. The site of injury should be immobilized, sedatives given to allay the pain, and the pneumothorax watched carefully and relieved if necessary as just described. Pulmonary bleeding is usually controlled by the collapse of the lung from the pneumothorax which has been established; hemorrhage from the intercostal vessels is unusual in this type of trauma.

Similar to this class of closed thoracic injuries are the puncture wounds with pleuropulmonary involvement, such as are usually made by ice-picks and instruments of like calibre. Nor is the treatment in any way different from that already outlined, unless an intercostal or internal mammary vessel has been injured. Hemorrhage from this source, which is all too frequently overlooked, calls for open operation with ligation of the vessel and very probably a transfusion, as the loss of blood is often considerable. Empyema is rare following such trauma and unless some large vessel near the root of the lungs or in the mediastinum has been injured these patients usually make uneventful recoveries with conservative measures.

The most serious and distressing of these injuries are those with multiple bilateral rib fractures due to crushing of the entire chest. The patient is in shock; there may be a bilateral pneumothorax with extreme respiratory embarrassment; there may be

fracture and depression of the manubrium with venous obstruction in the superior mediastinum with petechial hemorrhages over the face and neck. First, as with all thoracic trauma, the head of the bed is elevated to the maximum comfort of the patient. Second, the pneumothorax or hemopneumothorax must be relieved, sometimes from both sides, as outlined above. Third, sedation to allay pain and support to the chest, either with sand-bags or with a binder, should be provided. If opium is used, frequent small doses are better than occasional large ones, as there is much less respiratory depression when the drug is so administered. Fourth, the patient should be placed in a high oxygen content atmosphere—preferably an oxygen tent or by nasopharyngeal administration—so as to permit as complete ventilation of the lungs as possible and adequate oxygenation with the minimum of effort. Fifth, a transfusion should be given and repeated if necessary, the amount to depend upon the response of the patient; it is the best way to combat shock and will also break through the acapnea that is building up due to the rapid shallow breathing with washing out of the $CO_2$, and increase the oxygen combing power of the blood. Sixth, if the manubrium is depressed sufficiently to cause real obstruction it will be necessary to elevate it. The mortality among these patients is high and the pneumonia morbidity great. Still, by prompt action, much may be accomplished with some of them.

### WOUNDS OF THE CHEST WALL COMMUNICATING WITH PLEURA OR LUNG

If there is a large gaping wound in the chest wall communicating with the pleura or lung, the opening should at once be covered or packed with anything at hand to stop the inrush of air and then be debrided and repaired with simultaneous repair of the pulmonary wound, the lung re-expanded and the parietal opening sutured; closed drainage should be provided at the dependent portion of the pleural cavity. If progress is favorable and there is no evidence of suppuration, the drain may be removed in three or four days. Again, if there is hemorrhage from an intercostal or internal mammary vessel or if a foreign body, such as clothing or other foreign material is present in the chest, the thorax should be widely opened and suitable repair and toilet performed. Unless a very large vessel in the lung has been injured, pulmonary bleeding is usually controlled by the accompanying pneumothorax, and open thoracotomy with lung suture is unnecessary as a rule. This must be adjudged from the general condition of the patient, however, and from the signs of continuing hemorrhage and increasing fluid. In all these compounded thoracic wounds that are not operated upon, and do not require suture, the patient is placed on the injured side with the wound as dependent as possible. If he is kept in this position for four or five hours, it is astonishing how much old blood will drain out of the thorax. Except as already noted above, conservative treatment is followed and the whole attention is directed to restoring the intrapleural balance to normal at the earliest possible date. Thus twenty-four to forty-eight hours after the patient has become stabilized, if there is fluid or blood present within the chest, it is aspirated and partly replaced with air. This controls further hemorrhage, permits more rapid re-expansion of the lung, decreases the likelihood of fibrosis of the pleura from organization of the blood clot, and lessens the chance for empyema.

I cannot emphasize too strongly the necessity of aspirating an hemothorax of any appreciable size. The continued presence and organization of blood in the pleural cavity causes very marked thickening of the pleura and is likely to prevent re-expansion of the lung, resulting in an exceedingly dense fibrothorax with extensive retraction, the late appearance of empyema in the residual thick-walled pleural space, and the development of

bronchiectasis in the carnified atelectatic underlying lung.

### WOUNDS OF THE PERICARDIUM AND HEART

Penetrating wounds involving pericardium, heart, and pleura are usually promptly fatal from hemorrhage; this is particularly true when the auricles are involved. Where the ventricles have been penetrated, however, the leak into the sac may be relatively slow and tamponade results, which of itself tends to check the bleeding. The diagnosis is based upon the marked dyspnea, cyanosis and pallor, distension of the veins of the neck, very small or absent pulse, low blood pressure, enlarged area of cardiac dulness, absence of heart sounds, and—if examined by fluoroscope, which is extremely helpful—absence of pulsation of the cardiac shadow. The wound is usually to the left of the sternum, or close to its right border, and there is evidence of profuse external hemorrhage, though by the time the patient is seen this may be a mere trickle due to the pericardial tamponade that has been built up. Also there may be a history of continued activity following the trauma and then sudden syncope. Even in the presence of apparent death, according to Bullock, up to thirty minutes prompt operation is indicated with removal of two or three costal cartilages, incision of the pericardium and evacuation of the blood, control and suture of the wound in the heart, and gentle massage of the organ if pulsation has ceased. Even though no movement is visible it may resume its beat once the tamponade has been removed. The pericardium is then closed tight, meticulous asepsis being preserved to guard against infection. After the repair is completed a transfusion should be given. If a pneumothorax is also present, the pleura is aspirated before closing and the lung reexpanded provided it has not been damaged. During convalescence re-accumulation of the fluid or blood in the pericardium or pleura must be looked for and relieved when necessary. This group of injuries is not as hopeless as was formerly the opinion. Elkins has recently reported a series of thirteen cases of his own. Twelve were operated upon with six deaths. The thirteenth patient recovered spontaneously. He has found that 2 per cent of penetrating wounds of the thorax involve the heart and from his own experience and a review of the literature states that with prompt operation about fifty per cent of these should recover. The secret of success lies in early diagnosis and prompt operation. If in doubt he feels the more conservative treatment is operation. The surest diagnostic aid is the absence of pulsation of the heart when examined under the fluoroscope.

### THE MEDIASTINUM: THORACIC DUCT AND ESOPHAGUS

Wounds of the thoracic duct cause large recurring pleural chylous effusions. These at first may be mistaken for pus as the fluid is grey and sanguinous and appears usually one to three days following the injury; hence it is wise to await a bacteriological report before assuming the presence of empyema. If the fluid remains sterile treatment consists of repeated aspirations together with a low fat and high carbohydrate diet. Attempts at open repair are difficult and unsatisfactory and such repair is not necessary as the prognosis is good with the treatment described.

Penetrating injuries of the esophagus, on the other hand, are of exceedingly grave import due to the invariable rapidly ensuing mediastinitis. The usual etiology is from swallowed objects or improper instrumentation. An anaerobic phlegmonous type of infection develops within a few hours. As Eggers has so well shown surgical intervention must be prompt and adequate. First, the site of injury should be determined by esophagoscopy and incision made into the superior mediastinum at the base of the neck or posteriorly and the developing abscess drained and Dakinized with later counter incisions if necessary. Wounds of the lower esophagus involve the pleura,

and the mortality is very high from the fulminating infection which ensues.

### THE DIAPHRAGM

Acquired diaphragmatic hernia may result from direct trauma, with penetration of the muscle or the tear may be caused by indirect forces such as blows, falls, or crushing injuries of the chest or abdomen. Rupture of the left diaphragm is much more common than the right and the symptoms are more marked. Although the symptoms are generally latent, the possibility of such injury should always be borne in mind and the patient examined for it subjectively and objectively and by *x*-ray before discharge. The question of repair depends upon the severity of the symptoms, the size of the defect, and the general condition of the patient as to his ability to undergo a major surgical procedure. Needless to say the operation should never be undertaken by the neophyte. The various types of surgical procedure need not be gone into here but the condition itself should be considered and watched for following any injury of the thorax or abdomen.

### SUMMARY

In summarizing this brief consideration of thoracic injuries the following points may be recapitulated:

1. In wounds of the lungs and pleurae open operation is indicated to remove foreign bodies, to close gaping wounds, and to stop hemorrhage from an intercostal or internal mammary artery, but only rarely from the lung itself.

2. An hemothorax should be aspirated and the blood replaced by air.

3. The presence of a tension pneumothorax must be anticipated and relieved at once.

4. Otherwise, treatment should be conservative and supportive.

5. Wounds of the heart and pericardium, on the other hand, require immediate surgical intervention followed by transfusion.

# CONDITIONS ERRONEOUSLY DIAGNOSED AS APPENDICITIS*

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THE conditions that may be erroneously diagnosed as appendicitis are legion, and a consideration of all of them would require a compendium of abdominal diagnosis. Almost any condition at some time or in some way may mimic appendicitis, so that the appendix has been removed for almost every conceivable condition. Surgical literature gives evidence that appendectomy has at one time or another been advocated for the relief of practically every possible ailment, allergy, epilepsy, and chronic focal infection included.

The most common cause of acute abdominal pain is appendicitis and thereafter in the order of frequency occur cholecystitis; perforated gastroduodenal ulcer; acute pelvic conditions, such as ruptured extrauterine pregnancy, twisted ovarian cystoma, salpingitis; acute hematogenous infection of the kidney; acute diverticulitis; and mesenteric vascular occlusion.

Surgeons have long been impressed with the rôle of infections of the appendix as precursors to the development of gastric ulcer, cholecystitis and cholelithiasis, and associated pancreatitis. For the purpose of this discussion we will consider only acute appendicitis, and other pathologic conditions which are confused with it.

The symptomatology of acute appendicitis varies with age, and accordingly the symptoms in infancy, adolescence, adult life and old age are materially different. The symptomatology is based upon the morphology of the appendix and parallels the pathologic changes therein. Pain is the outstanding feature of acute appendicitis in the young, active individual, and usually renders acute appendicitis an emergency condition, with indication for immediate operation. On the other hand, abdominal operations undertaken for pain and not upon the basis of a pathologic diagnosis are often performed under the erroneous diagnosis of appendicitis. A few years ago we had occasion to tabulate a thousand cases of tabes dorsalis and found that 10.1 per cent of the individuals had had an abdominal operation. In these individuals the operative indication was an acute abdominal pain and the surgical procedures were directed against every organ within the abdomen.

Abdominal pain is in general of two types: (1) A colicky pain, coming on like a stroke of lightning, of maximum intensity, then falling away and with a clear interval without pain. The mechanism of production of this type of pain is a neuromuscular stimulation, typical examples of which are biliary colic, intestinal obstruction and the uterine contractions at term. (2) A constant, localized pain due to an inflammatory and exudative process. This pain requires the element of time for its production and is seen most typically in any pathologic process within the abdominal cavity which is characterized by local exudation.

In colicky pain the individual is restless and moves about, seeking to ease the pain by assuming various postural or decubital positions. In the pain of inflammatory origin there is no movement, and the patient is immobilized in a fixed position, usually in bed.

The appendix is a blind tube with a variable lumen. In the adult its smallest diameter is at the point of junction with the cecum, sometimes called the valve of

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Gerlach. There is usually a strong, inelastic submucous layer which is present throughout the entire length of the appendix. This inelastic layer makes a strong, restraining sheath and offers a considerable obstacle to perforation. In children, the submucous layer is absent, and the lumen of the appendix greater. This accounts for the lack of sequential and precise symptomatology in acute appendicitis in children. By reason of the wide diameter of the lumen of the appendix in children, intracecal drainage of the appendiceal contents is more apt to occur than in the adult. This saving value is, however, counterbalanced by the extreme ease with which perforation occurs in children, owing to the absence of the submucous layer.

The etiologic factor in acute appendicitis is always the infection and this infection begins in almost 99 per cent of cases within the mucosa. There is a rapid swelling of the mucous membrane, which cannot expand owing to the firm retaining fibrous tissue of the submucous layer; the products of infection are thus retained under pressure, and an empyema results. The symptomatology that follows this rather simple pathologic process begins by the onset of pain, colicky in character, occurring suddenly, and severe and recurrent in character. It is a primary peritoneal pain due to violent peristalsis of the small intestine and is referred to the epigastrium. Hyperperistalsis associated with intermittent colicky pain occurs only above the provoking cause. With the onset of pain there is usually a sense of nausea with occasional vomiting, but if cathartics or salts are not given, the nausea and vomiting rapidly subside. The entire abdominal wall is generally sensitive, though not necessarily spastic. An accurately taken rectal temperature record will reveal some slight elevation in temperature. With rare exceptions, the onset of symptoms is paralleled by leucocytosis and polynucleosis of some degree.

An infection which has thus begun in the appendix may terminate in one of three ways: (1) drainage through the appendix into the cecum with resolution; (2) perforation; or (3) a combined suppurative and gangrenous process. The moment the infection reaches the serosa, the general abdominal symptomatology changes and the symptoms and signs point unerringly to a pathologic process in the appendix. The pain becomes constant in character. It is localized to the right lower quadrant; nausea and vomiting have ceased; the generalized abdominal sensibility has become a local tender point capable of accurate focalization; and, for the time being, the temperature has subsided, although the leucocytosis and polynucleosis continue or increase. At this stage the condition is usually diagnosed as appendicitis, although pathologically it is essentially a localized peritonitis. Perforation, rupture or gangrene means that the pus pressure of the empyema is temporarily relieved and absorption for the time being is diminished, but the danger to the individual has become markedly increased. It is unfortunate that it is at this stage that surgical postponement and medical procrastination usually take place.

The moment the serosa becomes involved, the peritoneum of the surrounding intestines begins to throw out first a transudate, then an exudate. This is manifest in the form of a plastic lymph or fibrinous material and is truly protective, for it encloses or erects barriers against the spread of the peritoneal infection. The intestines are held fixed, distention occurs, and peristaltic activity is inhibited. The patient, family or friends, however, attempt to correct the abdominal distention by drastic cathartics, with the result that a local peritonitis is rapidly converted into a condition of ascending pathologic severity with the development of a generalized or diffuse peritonitis.

There are very few abdominal conditions that arise in as precise a manner as appendicitis and it is well to remember that the sudden onset of acute, cramp-like abdominal pain is the first and most important warning symptom.

If one reflects that the individual who develops acute appendicitis is ordinarily enjoying good health, it is clear that a sudden attack of abdominal pain in any patient with this type of onset should lead to a strong suspicion of appendicitis. In no field of surgery are the errors of omission associated with such a terrible mortality, and, in a like measure, in probably no other field of surgery are errors of commission attended with such slight risks to the individual. As a matter of surgical philosophy, it seems to be better to take out a perfectly innocent appendix than to face the menace of perforation and peritonitis.

Conditions that may simulate acute appendicitis may be arranged for the purposes of diagnosis into seven well-defined groups:

I. Conditions of the gut-tube.

II. Conditions having an etiologic origin from the gut-tube but the major pathological condition in other areas or organs.

III. Conditions arising from the retroperitoneal tissues.

IV. Conditions primarily thoracic with symptoms of referred pain.

V. Conditions arising from disease of the peritoneum and pelvis.

VI. Conditions arising from cerebrospinal disease.

VII. General systemic conditions or remote disease.

I. The following pathologic conditions of the gut-tube may occasion an erroneous diagnosis of acute appendicitis:

1. Gastroduodenal ulceration.
2. Cholecystitis and pancreatitis.
3. Neoplasm of colon, particularly of the cecum and ascending colon.
4. Acute mesenteric adenitis.
5. Meckel's diverticulitis.
6. Intestinal obstruction.
7. Hyperplastic tuberculosis of cecum.
8. Regional ileitis.
9. Ulcerative colitis.
10. Spastic colitis.
11. Chronic constipation.
12. Intussusception.
13. Diverticulitis.
14. Mesenteric vascular occlusion.

II. Conditions having an etiologic origin from the gut-tube, but with the major pathologic condition in other areas or organs, which may cause incorrect diagnoses of appendicitis, are:

1. Subphrenic abscess.
2. Septic pylephlebitis.
3. Retroperitoneal phlegmon.
4. Perinephritic abscess.
5. Hepatic abscess.
6. Amebiasis.

III. Conditions arising from the retroperitoneal tissues, and simulating acute appendicitis may be:

1. Acute hematogenous infection of the kidney.
2. Nephrolithiasis.
3. Renal neoplasm.
4. Nephroptosis—Dietl's crisis.
5. Ureteral calculus or stricture.
6. Perinephritic abscess.
7. Retroperitoneal neoplasm, such as lymphosarcoma.
8. Right-sided pyelitis in children and women.

IV. Conditions, primarily thoracic, with symptoms of referred pain, simulating acute appendicitis are:

1. Pneumonia.
2. Pleurisy.
3. Chronic tuberculosis of lungs.
4. Cardiac disease.
5. Intercostal neuralgia.

V. Conditions arising from disease of the peritoneum and pelvis which may give the appearance of acute appendicitis are:

1. Tuberculous peritonitis.
2. Tubal disease.
3. Ectopic gestation.
4. Ovarian cysts.
5. Pneumococcus peritonitis.
6. Torsion of omentum.
7. Gangrene of appendices epiploicae.
8. Pelvic allergy.

VI. Conditions arising from cerebrospinal disease, which may give the appearance of appendiceal inflammation are:

1. Tabes dorsalis.
2. Spinal tumor.
3. Incipient meningitis.
4. Brain tumor.

VII. General systemic conditions or remote disease, simulating appendicitis, include:

1. Sepsis, infarcts of spleen, etc.
2. Lead poisoning.
3. Incipient diabetic coma.
4. Uremia.
5. Visceral manifestations, such as erythema exudativa and angioneurotic edema.
6. Acute follicular tonsillitis.
7. Herpes zoster.
8. Peritonismus.

This classification does not take into consideration the anomalous symptomatology of acute appendicitis in the aged, nor the false or family appendicitis (one member of the family may have had a real acute appendicitis, but the other members of the family soon manifest "appendicitis hypochondriasis" and present themselves with a congeries of symptoms to demand appendectomy).

Many of the conditions indicated in this synoptic presentation are so rare that they are not considered in the ordinary diagnostic survey. It has been our experience that the conditions most frequently mistaken for acute appendicitis are insidious perforation of gastric and duodenal ulcers, particularly the latter; atypical attacks of biliary colic, central pneumonia, diaphragmatic pleurisy, perinephritic abscess, ectopic gestation and hemorrhagic cysts of the ovary, and ureteral calculus on the right side.

Acute perforation of a duodenal ulcer is usually so dramatic with every major symptom presenting itself, that it is seldom confused with acute appendicitis. However, the patient who has had a duodenal ulcer with its cyclic symptomatology may have his pain become continuous. This transformation of a cyclic to a continuous fixed pain is significant, in that the ulcer has approached the serosa and local exudation is taking place. With this condition, a slow leak will occasion a drainage of some material to the right loin and down the right paracolonic fossa. The localizing pain, spasticity, and rigidity would then be maximum in the area of the right lower quadrant and suggest acute appendicitis. In such a case it is not an uncommon experience for the appendix to be explored; since the pathology in the appendix is insufficient to account for the picture, further exploration reveals the perforation in the gastroduodenal zone. Although appendicitis is the most frequent acute inflammatory condition in the abdomen, the diagnostic importance of this numerical frequency is many times forgotten.

The indigestion of gastroduodenal ulceration is a chronic condition characterised by four outstanding features: (1) it is tolerated without great distress; (2) it bears a relationship to the ingestion of food; (3) it is cyclic in character, recurring day after day with the same precision; and (4) the chronicity and the repetitious character of the complaint are present in the history of most patients. It is the regularity and cyclic recurrence of the symptoms in ulcer that render this diagnosis relatively easy by an analysis of the clinical history.

In gall-bladder disease the early and inaugural symptoms are those of a gaseous indigestion, occurring usually in women after the third decade of life, and associated with slight or no impairment in the physical condition, this is a significant history. The examining physician can believe that gall-bladder disease is the proper diagnosis if to this is added an attack of pain, colicky in character, beginning as a rule in the right upper quadrant and radiating to the back, associated with marked restlessness and requiring a hypodermic by reason of its intensity.

The most confusing condition erroneously diagnosed as acute appendicitis occurs in children up to about the twelfth year, when there is a generalized abdominal pain, with generalized abdominal sensibility and a more marked response to pres-

sure in or about McBurney's point. Here the physician should always be on his guard for the possibility of an undeclared central pneumonia. A careful study of the temperature and pulse ratio will usually indicate a variation from the normal. For each degree of temperature there should be an increase of 10 in the pulse rate, and an increase of 2 to 4 per minute in respiration. In the pneumonic group with abdominal symptoms this ratio is disturbed, with respiratory rate out of proportion to the temperature and pulse. The leucocytosis and polynucleosis are as a rule higher and more marked in pulmonary pathology than in acute appendicitis.

Pathologic conditions in the kidney, such as acute hematogenous infection, ureteral calculus, or perinephritic abscess, usually have certain distinctive earmarks. Acute hematogenous infection of the kidney is an embolic process and the systemic prostration is out of all proportion to the local abdominal symptoms. Ureteral calculus is sudden in its onset and the pain has its origin posteriorly with a successive segmental arrangement downward. However, pyelitis in women and children must always be canvassed, although it seldom reaches the dramatic and acute presentation of a frank appendicitis. It is well to remember that appendicitis occurs preeminently in the well, healthy, able individual. While it may occur in people who are ill of other conditions, the evidence of a pre-existing debilitating illness, a previous loss of weight and anemia of unexplained origin, followed by an acute attack of pain localized to the right side, is more often significant of neoplastic conditions of the colon or retroperitoneal space than of a frank appendicitis.

Pain in the lower abdomen below the navel, occurring in females, may be correlated with pathologic conditions of the adnexa. Pelvic peritonitis of tubal origin gives a history of previous attacks before the doctor has been called. Ectopic gestation is indicated by some slight but distinct change in the normal menstrual flow. Hemorrhage into an ovarian cyst or a twisted ovarian pedicle may be distinguished by eliciting a ballotable tumor on bimanual examination. Acute salpingitis may mimic acute perforating appendicitis with remarkable accuracy.

Acute tonsillitis in young individuals can give rather marked abdominal symptoms, so that in young children the nose and throat, should be canvassed. In children, the possibility of pyelitis should also be kept in mind.

I have not thus far discussed the blood count as a diagnostic aid. Although its importance is very great, the diagnosis of acute appendicitis cannot be made on a blood count alone. The blood count offers corroborative evidence to the history and the physical examination. There are few abdominal conditions which have so precise a history and so definite a clinical course as the ordinary frank case of acute appendicitis. When the clinician considers chronic inflammatory disease of the appendix as contrasted with the acute suppurative or gangrenous appendicitis, he introduces a symptomatology which may mimic any intra-abdominal condition.

## SUMMARY

1. Attention has been directed to the fact that abdominal pain may have its origin in disturbances of the cerebrospinal system, the thorax, the retroperitoneal space, in addition to intraperitoneal pathology.

2. A number of conditions which may simulate acute appendicitis have been indicated.

3. An analysis of the history, with complete and accurate physical examination will eliminate most of these conditions and make possible an accurate diagnosis.

4. The value of systematic elimination in diagnosis is accentuated.

# APPENDICITIS FROM A HISTOLOGICAL STANDPOINT*

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THE microscope has the final word in the diagnosis of appendicitis but unfortunately the opinion it permits is not available until the case is about over. The clinical diagnosis may or may not be correct; the operative diagnosis certainly varies, a fact which is quite easy to understand when we consider that the gross diagnosis by either the surgeon or the pathologist is not always reliable; but the histological diagnosis, other things being equal, affords as near an accurate diagnosis as is now possible.

There are certain developments in the pathogenesis of appendicitis which aid this accuracy. Beginning with a superficial epithelial lesion, the process spreads in the form of a wedge from the mucosa to the serosa and then rapidly lengthwise in the muscular and serous coats, involving even the proximal portion quite early. This tendency of the inflammatory process to localize in the outer layers, Seng makes clear in his description of the lymphatic system of the appendix. All this makes for certain histologic, diagnostic advantages. If the appendix is the seat of a classical and well developed appendicitis it is very easy to diagnose by simple gross inspection. If the lesion is less typical or less well developed, as in a very mild or subacute case, it is less susceptible to accurate gross diagnosis though careful inspection and palpation may suggest, the proper site for microscopic sectioning. And in a few cases, the organ may be macroscopically normal in appearance and yet the microscope detect evidence of a very mild attack, a regressive lesion, or a past event. We are able to do this because of this peculiar spread of the process. Beginning in the mucosa, with its mass of lymphoid tissue, it is not easy to detect an inflammatory exudate, especially in slight cases. But with its rapid spread into the submucosa and muscular and serous layers, its recognition becomes a very simple matter. Then, too, if the microscopic sections are inadvertently not selected at the level of maximum inflammation, it is not a serious error because the rapid longitudinal spread of the cellular exudate in the muscular and serous layers plainly indicates the condition present. The pathologist therefore need not rely solely upon the confusing mucosa but may obtain conclusive evidence in the much more satisfactorily studied submucosal, muscular and serous layers. These remarks hardly apply to the classical case in which the appendicitis is obvious at a glance: they concern the mildest case on the positive side and the decision for the diagnosis of normal appendix on the negative side.

In the two years from June 25, 1935, to June 25, 1936, we received from the Surgical Service at Hahnemann Hospital 937 appendices with the clinical and operative diagnosis of appendicitis and suitable for diagnostic analysis on a histologic basis. These constituted 42.6 per cent of all removed surgical specimens sent to the laboratory and suggest the frequency and importance of appendectomy in a surgical service. In addition, there were two examples of carcinoid and one tuberculous appendix, all mistakenly diagnosed appendicitis, one mucocele and a few appendices too dessicated for satisfactory examination. There were further some 300 appendices removed during operations on other organs, mostly gynecological and

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gall-bladder operations. These were examined histologically but not included in the following analysis which is confined to 937 appendices mentioned. These 937 appendices were examined grossly after fixation, sectioned at what seemed the most appropriate site, imbedded in paraffin, cut and stained with hematoxylin and eosin and examined and diagnosed microscopically. In preparing this paper, all these sections were re-examined critically for the purpose of confirming or rejecting the original diagnosis, and ten diagnostic changes were made in borderline cases mostly from normal to a pathological status as we wished to avoid any seeming prejudicial bias.

The histologic diagnoses reached were as follows:

| | | Per Cent |
|---|---|---|
| Acute appendicitis | 277 | 29.5 |
| Subacute appendicitis | 43 | 4.6 |
| Chronic appendicitis | 18 | 1.9 |
| Appendicitis obliterans | 34 | 3.7 |
| Negative or normal appendices | 565 | 60.3 |

The cases of acute appendicitis showed the classical appendiceal inflammation. Most of them were the suppurative, ulcerative or gangrenous types; some were milder but with a definite polynuclear exudate; all were unmistakable examples of acute inflammation. The subacute group were mild, non-suppurative or recurring types. They may also have been examples of very early, regressive or healing stages. Some of these were probably what Aschoff calls appendicitis fugax or abortive or fugitive appendicitis. The chronic appendicitis group were diagnosed on intact but much thickened and fibrosed walls and little or no cellular exudate: they probably represent the cumulative effect of recurring attacks. The propriety of the term may be questioned. Appendicitis obliterans in this paper is applied to appendices in which the lumen and mucosa have disappeared to be replaced by fibrous and fatty tissue without thickening of the organ, but rather atrophy. Some consider these cases of non-inflammatory atrophy; if they are admitted as appendicitis types, they could be properly called healed appendicitis.

The high percentage, over 60, of negative or normal appendices will probably be questioned, but in these cases, there was no evidence of an inflammatory process in any part of the wall and where there is no evidence of inflammation, it does not seem rational to pronounce the process inflammatory simply to agree with the clinical diagnosis. There may have been other reasons for the appendiceal symptoms such as fecal concretions, worm infections, chronic stasis, or periappendicular conditions. If appendicitis is to be an inclusive clinical term indicative of any pathology in the appendiceal region, justified by the menace of the real condition, well and good. But if appendicitis means inflammation of the appendix, then evidence of such a process should not be wanting in the meticulous histologic examination of the organ. We are not alone in finding normal organs among cases diagnosed appendicitis. Aschoff in his series of 1000 appendices found 465 cases diagnosed acute appendicitis in which 25 per cent failed to show evidence of the diseases, 347 cases diagnosed chronic appendicitis in which evidence of appendicitis was lacking in 50 per cent of the cases; and thirty-five cases diagnosed subacute appendicitis with a diagnostic error of 35 per cent. In a total of these 847 cases diagnosed appendicitis, Aschoff found no evidence of it in 35 per cent, or roughly one-third of the cases. He quotes Sonnenburg as thinking that the proportion of wrong diagnoses in women is as high as 33 per cent.

Aschoff stresses the use of the oxydase reaction in detecting slight examples of appendicitis, "fugitive appendicitis," which would otherwise be missed. We did not employ this method and therefore may have missed some abortive cases. We also may have missed some by not sectioning the appendix from base to tip. But granting this, we feel there would still be a considerable number of patients in which the organ

was certainly structurally normal. In our efforts not to omit any cases of appendicitis we included in this list appendices which only showed an occasional eosinophile or neutrophile in the muscular or serous coat. For those who entertain the term "catarrhal appendicitis," a division not much favored, we may say we viewed our sections with this in mind without finding the necessity of changing our diagnoses. There were six cases showing the oxyuris in the lumen; five of these were normal appendices and one showed a very mild or subacute condition. Aschoff found oxyuris infection much more commonly, in 5.9 per cent of his acute cases and 14.6 per cent of the chronic types showed worms but all were free of appendicitis. We would probably have found more with a more thorough search especially of the base of the organ, but the matter is not important as far as appendicitis is concerned, it being pretty well established worm infection does not cause appendiceal inflammation.

While the percentage of negative or normal appendices in our series is surprisingly high, it seems no less remarkable to us that in surgical reports the finding of normal appendices is either unmentioned or minimized. In Reid's report of 2921 cases of appendicitis, he states that there were 59 cases of mistaken diagnosis of appendicitis. This is only 2 per cent, truly a notable record. Hobler analyses 4833 cases of appendicitis, 1205 of which were "prophylactic appendectomies," i.e., those removed at the time of laparotomy for some other condition. Surely some of the latter were normal. Of his 2260 acute cases, 633 or 28 per cent had a pathologic diagnosis of acute catarrhal appendicitis or acute exacerbation of a chronic appendicitis. Could some of these have been normal especially when we consider the mortality rate was only .31 per cent? We find no mention of normal appendices in this large series of 4833 cases. Finney reviews 3913 cases which reached operation, but he does not list the removal of any normal appendices, for the entire group are tabulated under six types of appendicitis. Can any one conceive of no normal appendices among nearly 4000 appendectomies?

There were twenty-one deaths among our 937 cases, a total mortality of 2.2 per cent. Of the 338 cases which showed appendiceal inflammation, there were 20 deaths or 5.9 per cent; among the 565 negative or normal cases there was 1 death, a percentage of .18 per cent. Note how the last figures lower the average for the whole group and give a general low mortality for appendectomies. In Reid's 2921 cases there was a total mortality of 6.3 per cent but in the cases of acute unruptured appendicitis the mortality was only .86 per cent. Hobler's mortality figures for 3628 cases of appendicitis were 3 per cent, with 4.3 per cent mortality in the acute cases and .58 per cent in the chronic types. Finney shows a very low mortality in his chronic group of 2106 cases comprising chronic, recurrent and subacute types, only .095 per cent. The closeness of the figures in the chronic and unruptured group of others and our own 565 negative or normal group suggests that in probably many instances we are all talking about the same thing. We speak of them in terms of normal; the surgeons in terms of appendicitis.

## SUMMARY AND COMMENT

In the examination and re-examination of 937 appendices removed under the diagnosis of appendicitis, we found about 60 per cent normal structurally. This percentage may indeed be too high but attention is called to Aschoff's findings of 35 per cent of negative or normal cases in his series of 847 cases diagnosed and operated as appendicitis. And we are convinced from this study that many normal appendices are removed though the surgeons are reluctant to accept this diagnosis and prefer to record them as examples of appendicitis. Though the various surgical organizations have insisted on every removed appendix being subjected to patho-

logic examination, it is not unusual for the surgeon to ignore the pathologic diagnosis in favor of the clinical opinion. In our own series, all these cases still stand with a final clinical diagnosis of appendicitis. We doubt if there are many surgeons who would complete a record with the final diagnosis of "normal appendix" even if their own operative findings and pathologic diagnosis agreed on this. Operative statistics suggest that many normal appendices are listed as examples of chronic and subacute appendicitis. Surely we are wrong in not admitting by clinical record or published articles that some removed appendices are normal. Finney, even though he has no normal appendices listed in his survey of 3913 appendectomies, says "it would seem to us much better to remove a half a dozen relatively normal appendices by emergency operations than to be responsible for the consequences which may attend waiting too long on one." We believe this is just what is done and rightly so.

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"I have examined several years' statistics of appendicitis and never found any suggestion of an endemic character. In the autumn of 1932 an endemic of infective pharyngitis, and to a lesser degree tonsillitis, was widespread. The number of cases of appendicitis was strictly within the average of other years."

From—"Appendicitis. A Clinical Study," by W. H. Bowen (Macmillan).

# PLEXIFORM NEUROMA OF APPENDIX*

## WITH A STUDY OF 600 APPENDICES

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IN his discussion of tumors of the nerve trunks, Ewing[1] describes plexiform neuroma as follows: "While in most cases of neurofibromatosis the nerve fibers are passive and gradually atrophy, there are rare forms of overgrowth of nerve trunks and ganglia in which the nervous elements take part in the hyperplasia. In certain plexiform neuromas of neck, back, eyelid and face, the elongated, nodular and contorted nerve trunks show preservation of nerve fibers, and Ziegler, Birch-Hirschfeld and Klebs believe there may be an active overgrowth of nerve fibers.

"In the cirsoid neuroma, which consists of a congeries of elongated and irregularly thickened nerve trunks, Ziegler points out that the bulk of nerve tissue is greatly in excess of that normally provided for the affected part. These processes seem to stand in an intermediate position between genuine neuroma and neurofibroma. Thoma describes neuroma of the Pacinian bodies of the skin, producing small painful tumors which are chiefly fibrous, but may show overgrowth of nerve fibers."

Elsewhere Ewing takes issue with Verocay's conception[2] that the tissue of neurofibroma is not connective, but consists of nerve cells or their embryonal equivalents, which have not been properly employed in the development of the nervous system. Verocay suggested, on the basis of his theory, that these growths be called "neurinoma." But Ewing seems to think that only if the cells of the sheath of Schwann can be proved specialized nerve or glia cells, is this interpretation acceptable. Ewing therefore, continues to class all such growths as neuroma rather than neurinoma, and this nomenclature has been adopted by later writers, notably Masson and Hosoi.

That neuromatous tumors are sometimes found in appendices in which the lumen has become obliterated was observed by P. Masson[3] of Montreal in 1921, and independently in the same year by Maresch.[4] Both these investigators believed that the growths arose in this particular situation in the same manner that the neural proliferations occur upon the stumps of amputated nerves. The injury, in this instance, had occurred through division of the nerve filaments by an ulcerative or inflammatory process, which was the cause of the closing up of the appendicular lumen. The effect upon the nerves of the mucosa, they argued, would be the same as when they had been severed by instruments.

When the attention of surgeons had once been drawn to the possibility of the occurrence of neuroma in the appendix, other observations were shortly forthcoming. Such neurinomata as had been described by Verocay were observed and reported by Schweizer in 1922.[5] Among twelve appendices removed because of chronic appendicitis and found to have obliterated lumina when post-operatively examined, five proved on microscopic examination to be neuromatous in structure. In doing routine autopsies, twenty obliterated appendices were obtained, and among these no less than fifteen contained neuromatous structures. Ursch,[6] working in the Surgical Clinic at Lausanne, found in a series of 400 appendices removed *à froid*, i.e., in the interval between acute attacks, or in per-

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sistently chronic cases, conditions which he describes as follows:

Attention is drawn to the appendix because of its size and its particularly curious form. It is divided into two parts, the proportional size of these parts varying considerably in different cases. In the region of the apex the appendicular tissue will be found to have been transformed into a fibrous cord having the dimensions of a knitting needle, white or grayish in color, looking more or less like scar tissue. The form assumed by the intermediate zone is truly astonishing. The mesoappendix is small and retracted, the entire organ being frequently bound to the cecum by thin fibrous adhesions which are easily severed.

This description must be varied to fit individual cases, but one feature, at least, is constant: the retracted part is always distal; the appendix is never found amputated, and the extension of the sclerosing process is always straight downward, from the apex toward the base. This shows that the condition under discussion is by no means identical with the simple process of obliteration of the lumen, so often seen after an acute attack of appendicitis, where the lumen will be obliterated at the point where the inflammation has destroyed the mucosa.

In its cecal portion, the appendix presents a normal structure; the different planes are well preserved, the mucosa is intact, the glands of Lieberkühn and the lymphoid tissue are well developed and normal in appearance. There are no signs of inflammation.

But in the distal portion we see an entirely different picture. There the mucosa has disappeared and the lumen is obliterated. In its place will be found thick conjunctive tissue wherein, because of their peculiar coloring, it is easy to make out masses of nervous tissue formations, containing Schwann's cells in abundance. This modification affects only the deepest layers of the appendiceal wall. The serosa, the subserosa, and the muscularis ranged about this central axis, have preserved their normal anatomic characteristics intact.

These proliferations of nervous tissue are characteristic of neurogenic appendicitis. They are made up of manifestly superabundant nerve fibrils which are connected only with the intramucosal nerve plexus, at the expense of which they are developed. The plexuses of Meissner and Auerbach are intact.

In the first place, the epithelium of the mucosa disappears at the distal extremity of the appendix. Then the lumen is progressively obliterated from the apex downward toward the base, the lymphoid cells rarefy, but the nerves of the mucous plexus persist, hypertrophy, and pile themselves up in an irregular mass. Neuromas now begin to form. Isolated when small, these neoformations rapidly extend until they occupy the whole extent of the lumen, multiplying until they occupy all the central part of the appendix. It is upon their number and their size that the length of the obliterated segment depends. The fibers of the periglandular plexus contain three or four times the normal number of nerve tubules. Argentaffine cells, arising as offshoots of Lieberkühn's glands, penetrate the mucous plexus; their presence appears to be the primordial condition upon which the development and persistence of the neuromata depend.

Masson, writing of "Neural Proliferations in the Vermiform Appendix" has stressed both the relationships and the differences between these neural proliferations of two different types and those other peculiar epithelial tumors known as carcinoids or argentaffin tumors, frequently found in the appendix. He sets forth the differences as follows:

In the first group, the proliferation begins in Meissner's plexus and extends to Auerbach's plexus. It is expressed by an increase in the number of nerves and, in certain instances, of ganglion cells also. Secondarily it involves the mucous plexus, forming neuromas of slender fibers tending toward the upper layers of the stroma. It is accompanied by hypertrophy, which may be enormous, of the muscular mechanism of the submucosa, of the muscularis mucosae, and secondarily, of the arterial muscle and of the muscular coat of the appendix. Such appendices are thick, sometimes gigantic, and have no tendency to involutional obliteration.

In the second group, only the deep region of the mucous plexus is affected, forming neuromas of large, non-medulated fibers which push the muscularis mucosae outward but never pass beyond it. The hyperplastic fibers always contain argentaffin cells of various shapes, emigrated from the crypts of Lieberkühn. These appendices show a marked tend-

ency to involutional obliteration of their lumen. The argentaffin cell neuromas survive the intestinal epithelium, they not only persist but also increase for a time. If they degenerate, it is always after the disappearance of the argentaffin cells.

The carcinoids spring from the 'neurocrine' argentaffin cells that inhabit the nerves of the mucosa and their neuromas. Born in the nerves, they infiltrate these nerves without destroying them.

Fig. 1. Note the open lumen of the appendix. To the right, and in the lower portion is the neuroma.

Differentiation of plexiform neuroma from argentaffin cell neuroma was assisted by the findings of a number of pathologists and clinicians, made in the decade following Masson's original presentation. Oberndorfer[7] reported a case where there was ganglion neuromatosis of the appendix, in addition to a primary growth of huge proportions, the length of the excised appendix being more than 16 cm. When the sections were stained, masses of ganglion cells arranged in groups, could be made out with the naked eye. Microscopically, the mesentery of the appendix was found to present a typically neurofibromatotic process, while in all parts of the wall there were an abnormal quantity of nerve fibrils. When Oberndorfer's report was made public it was criticized by Pick,[8] who believed that the condition found was a neuromatosis, rather than one which included an affection of the ganglions as well. The relation between this appendiceal condition, and von Recklinghausen's disease, as manifested on the surface of the body, still awaits further pathologic interpretation.

Similar reports were made by Schultz,[9] upon a specimen removed at routine autopsy; by Peritz[10] and by Schmincke,[11] who found neuromatous tumors when operating after attacks of acute appendicitis; and by Hoey[12] and by Hosoi[13] in patients suffering from von Recklinghausen's disease, who developed symptoms of what was clinically similar to acute inflammation of the appendix.

The most recent studies of neurofibromatosis of the appendix, as a clinical entity differentiated from argentaffin or carcinoid

FIG. 2. Sagittal section through the neuroma (knob-like mass to the right).

growths of that same portion of the intestinal tract, are those of Masson[3] and Hosoi,[2] both published in 1933. Masson does not add much to what he has already presented, but his summary of earlier work, and his original contributions to the technique of staining and identification of varied tissue structure, place him as the foremost authority upon a subject still in the throes of controversy. Hosoi's paper considers 195 cases of neuromatous growths of the vermiform appendix, 135 of which (69.2 per cent) were found with complete obliteration of the lumen. The use of Masson's trichrome stain enabled this investigator to recognize as neuromatotic 82 per cent of appendices with obliterated lumina. He advises the use of this staining method in all obliterated cases, so that no appendix shall be discarded as negative for neuromatosis without proper investigation. The growths appeared to him as "loosely anastomosing strands of non-medullated nerve fibers, or as islands of compact interlacing bundles of spindle-shaped cells, always located central to the muscularis mucosae. If the neuromatous tumor mass was large enough, the muscularis mucosae was closely apposed to it along the periphery, in the manner of a capsule. Rarely the tumor mass broke through the muscularis mucosae. These neuromatous growths contained a variable mixture of either argentaffin cells or lymphocytes."

For this study 600 appendices were used. Many special stains were done; Masson's trichrome was found most satisfactory. Serial study of these appendices revealed 202 neuromata. The macroscopic appearance of these appendices gave no evidence of a neuromatous mass, with the exception of one case which will be reported in detail.

The Masson trichrome stain brought out more positive findings than the other methods used. In this method the neuromas stain as red, loosely anastomosing strands of non-medullated nerve fibers or as red islands. The collagen sheaths stain blue.

The majority of neuromata were found in appendices obliterated either partially

or completely. The neuroma rarely breaks through the muscularis mucosae which usually acts as a capsule. These neuromas invaded by lymphocytes and widely separated fibers that are shrunken and evidently in full retrogression.

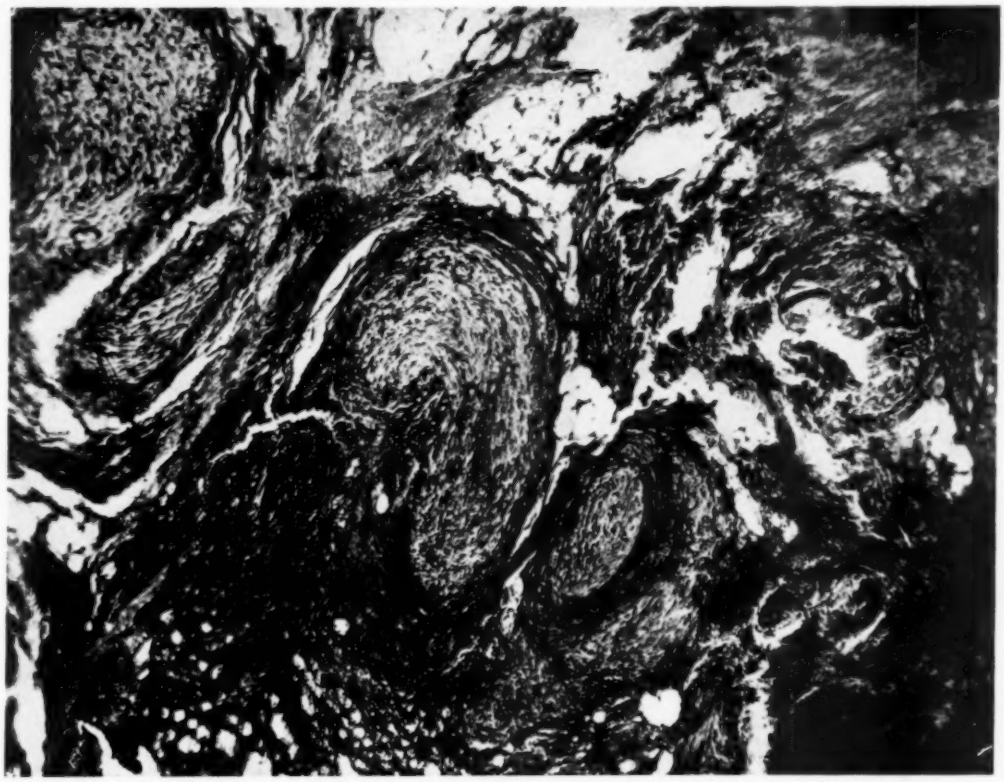

Fig. 3. Low power (160 ×), showing long axial neuroma surrounded by muscularis mucosae.

that appeared in non-obliterated appendices were seen in the mucosa. Of the 202 cases of neuroma in the appendix, we found 140 (64.3 per cent) were in the obliterative type and 82 (39.6 per cent) in the non-obliterative type. These figures agree with those of Hosoi and Masson. Out of the 82 of the non-obliterative type, 10 (12.1 per cent) were acute suppurative appendices; 22 (26.8 per cent) were subacute, while the rest were chronic.

The neuromata vary greatly from microscopic in size to a diameter of 2 to 3 mm., and are often multiple. Their microscopic appearance is different in different specimens. Some are formed of slender fibers, rich in Remak's nuclei, which are evidently in active growth; others have large fibers with scanty nuclei, which seem to have completed their growth; others, again, are

The physical examination of this series of cases is not at all diagnostic, ranging from rigidity in the lower right quadrant to no rigidity; from very mild to severe attacks of extreme agony with nausea and vomiting; from extreme tenderness to no tenderness. The blood counts except for the ten acute suppurative appendices reported were, of course, normal or nearly so. A rather important point to stress at this time is that many of the eighty so-called chronic subsiding appendices reported with symptoms might be placed in this group.

In view of Masson's statement that, "only twice have I seen neuromata which have passed the usual boundary of the muscularis mucosae and the external muscle coat as well," we feel that this present report would add another such case to the two that Masson mentions.

CASE REPORT

The subject was a male, age 63, with a previous history which had no bearing upon the abdominal condition. He considered himself well and rarely if ever consulted a physician.

On January 21, 1936, a septic tooth was extracted; within twenty-four hours there was a sharp attack of lower right abdominal pain. Medical aid was not sought for over three days, but in the meantime a member of the family gave the patient a dose of castor oil. When the patient was first seen by a physician, his abdomen was tender and slightly distended; the tongue was coated; the pulse was not particularly elevated. Urine was negative.

Blood count showed: W.B.C. 8,050, with polymorphonuclears 64 per cent, lymphocytes 33 per cent, monocytes 2 per cent, eosinophiles 1 per cent; R.B.C. 4,580,000; hemoglobin 84 per cent (Dare). The coagulation time was 5.

On February 17, 1936, following the mid-day meal, there was a slight attack of epigastric pain with a little nausea and vomiting. There was some discomfort in the lower abdominal region below McBurney's point with a little muscle rigidity. This was evidently another mild attack of appendicitis with a slightly increased leucocytosis. At that time the blood count was: W.B.C. 10,950; with polymorphonuclears 69 per cent, lymphocytes 31 per cent. The patient refused an operation.

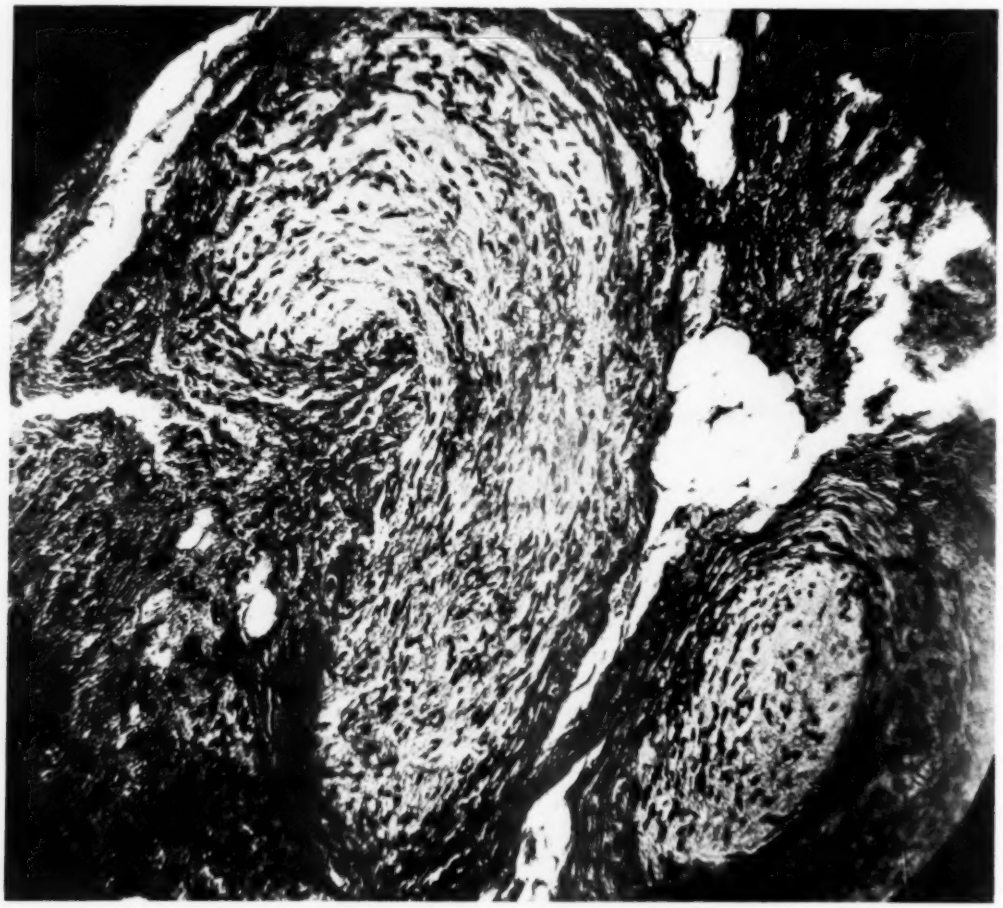

FIG. 4. High power (400 ×), showing the intricate lacy network of reticulum, forming tissue for the nerve fibers.

On November 19, 1936, about 10 P.M., after an ordinary dinner, the patient was seized with an acute abdominal pain followed about midnight by vomiting. The next morning, there was still a feeling of nausea present and some sensation of soreness in the right flank. Bimanual examination through the rectum illicited a tender area in the lower iliac region and toward the pelvis. There was no upper abdominal distress or tenderness. The blood-pressure was 172/102 and the pulse 62; temperature was 98 and respiration 20. An operation was performed.

At this time the blood count showed: W.B.C. 13,200 with polymorphonuclears 78 per cent, lymphocytes 21 per cent, monocytes 1 per cent; R.B.C. 5,100,000; hemoglobin 86 per cent (Dare) and coagulatin time 4½.

Urine analysis was reported as follows: Amber, clear, pH 7.3, specific gravity 1.023, occasional leucocyte, sediment slight mucus.

The post-operative condition was excellent and the patient made an uneventful recovery.

## PATHOLOGIC REPORT

*Macroscopic Examination.*—The appendix measured 4 by 3 cm. and was congested in the distal portion. The external venules were dilated and congested. About 1 cm. from the tip there was a round hard mass which was about 0.5 cm. in diameter. On cut section the mass was grayish-white in color, narrowed down, and appeared to be lost in the muscularis. The lumen was open. The wall was edematous and congested.

*Microscopic Examination.*—The tumefaction showed loosely anastomosing strands of non-medullated nerve fibers in a field of interlacing bundles of fibrous tissue together with fat. There were areas infiltrated with lymphocytes and surrounding these nerve fibers was dense connective tissue. No muscle cells were found. The rest of the appendix showed evidences of an acute inflammatory exudate.

*Diagnosis.*—Acute diffuse appendicitis (with plexiform neuroma).

## SUMMARY

Plexiform neuroma of the appendix as here reported has broken through the muscularis mucosae and appears in the subserosa. Only two such cases have previously been reported (Masson).

Neuromata are not unusual in the appendix and their presence is, possibly, the cause for the removal of a large number of so-called "chronic appendices."

Our knowledge of these neurogenic tumors arising in the vermiform appendix is still fragmentary and uncertain. Reports, with as detailed histopathologic data as are obtainable, are much to be desired. Only in this way may we hope to gain precision in the evaluation of clinical symptoms, and the ability to arrive at a correct diagnosis, and to differentiate between similar conditions arising not only in the appendix itself, but under like stimulus, in other portions of the body.

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# INTESTINAL TUBERCULOSIS

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THE study consists of seventy-five cases on which autopsies were done. The series is too small to warrant any definite conclusions, but is offered with the possibility of some value when considered with other similar series.

Of the seventy-five cases, sixty-seven were various forms of pulmonary tuberculosis. Five were non-tuberculous chest disease, two were non-tuberculous extra-pulmonary disease, and there was one case of tuberculosis of the bone.

Of the sixty-seven cases of pulmonary tuberculosis, none had been clinically diagnosed as minimal disease: sixty-one were far advanced, and the remaining six cases moderately so. From a pathological diagnosis, there were two cases of miliary tuberculosis, one of caseopneumonic tuberculosis, two of fibroid tuberculosis, and six of the fibrocaseous type. The remaining fifty-six cases were fibroulcerative cavernous tuberculosis.

The following chart shows a distribution according to the age and sex of the cases.

TABLE I

| Sex | Age | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0–9 | 10–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 | Total |
| Male... | 1 | 3 | 7 | 11 | 15 | 8 | 3 | 1 | 49 |
| Female. | 0 | 5 | 5 | 2 | 3 | 1 | 2 | 0 | 18 |

Better than 50 per cent (ten cases) of the females fall in the age range of 10–29 years; only 20 per cent (ten cases) of the males fall in the same group. Of the males, 50 per cent (twenty-six cases) of the cases fall in the age range of 30–49 years. It is also noted that forty-three of the sixty-seven cases come in the age period between 20 and 49 years.

Of the sixty-seven cases of pulmonary tuberculosis, forty-seven presented intestinal lesions.

Tables II–V show a distribution of cases of intestinal tuberculosis according to sex, age, clinical and pathological diagnosis.

TABLE II

| Type | Age | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0–9 | 10–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 |
| With Intestinal Tuberculosis Clinical: | | | | | | | | |
| Mod. Adv.: | | | | | | | | |
| male..... | .. | .. | .. | .. | 1 | .. | .. | 1 |
| female.... | .. | .. | 1 | | | | | |
| Far Adv.: | | | | | | | | |
| male..... | 1 | 3 | 5 | 8 | 9 | 3 | 1 | |
| female.... | .. | 5 | 3 | 2 | 3 | .. | 1 | |
| Total..... | 1 | 8 | 9 | 10 | 13 | 3 | 2 | 1 |

TABLE III

| Type | Age | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0–9 | 10–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 |
| With Intestinal Tuberculosis Pathological: | | | | | | | | |
| Miliary: | | | | | | | | |
| male..... | .. | .. | .. | 1 | | | | |
| female.... | | | | | | | | |
| Caseopneumonic: | | | | | | | | |
| male..... | .. | .. | 1 | | | | | |
| female.... | | | | | | | | |
| Fibroid: | | | | | | | | |
| male..... | .. | .. | .. | .. | .. | 1 | | |
| female.... | | | | | | | | |
| Fibrocaseous: | | | | | | | | |
| male..... | 1 | 1 | | | | | | |
| female.... | | | | | | | | |
| F.U.C.: | | | | | | | | |
| male..... | .. | 1 | 4 | 6 | 10 | 2 | 1 | 1 |
| female.... | .. | 6 | 4 | 3 | 3 | .. | 1 | |
| Total..... | 1 | 8 | 9 | 10 | 13 | 3 | 2 | 1 |

It is noted that 60 per cent (twenty-eight cases) of those cases with intestinal involvement, occurred before the age of 40 years. In those cases of pulmonary tuberculosis showing no intestinal involve-

ment, only 30 per cent (six cases) occurred before the age of 40 years.

Two of the six cases of fibrocaseous tuberculosis presented intestinal lesions and

Table IV

| Type | Age | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0–9 | 10–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 |
| Without Intestinal Tuberculosis | | | | | | | | |
| Clinical: | | | | | | | | |
| Mod. Adv. | | | | | | | | |
| male | .. | .. | .. | 1 | .. | 1 | | |
| female | .. | .. | .. | .. | 1 | | | |
| Far Adv. | | | | | | | | |
| male | .. | .. | 2 | 2 | 4 | 4 | 2 | |
| female | .. | .. | 1 | .. | .. | 1 | 1 | |
| Total | .. | .. | 3 | 3 | 5 | 6 | 3 | |

Table V

| Type | Age | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0–9 | 19–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 |
| Without Intestinal Tuberculosis | | | | | | | | |
| Pathological: | | | | | | | | |
| Miliary: | | | | | | | | |
| male | | | | | | | | |
| female | .. | .. | 1 | | | | | |
| Caseopneumonic: | | | | | | | | |
| male | | | | | | | | |
| female | | | | | | | | |
| Fibroid: | | | | | | | | |
| male | .. | .. | .. | .. | .. | 1 | | |
| female | | | | | | | | |
| Fibrocaseous: | | | | | | | | |
| male | .. | .. | .. | .. | 2 | .. | 1 | |
| female | .. | .. | .. | .. | .. | 1 | | |
| F.U.C.: | | | | | | | | |
| male | .. | .. | 2 | 3 | 2 | 4 | 1 | |
| female | .. | .. | .. | .. | 1 | .. | 1 | |
| Total | .. | .. | 3 | 3 | 5 | 6 | 3 | |

forty-two of the fifty-six cases of fibroulcerative cavernous tuberculosis showed intestinal tuberculosis. There appears to be no contradictory evidence to the statement that intestinal ulceration is associated with pulmonary ulceration.

As is usually the finding, the ileum and the caecum are the most frequent sites of intestinal tuberculosis. Next in frequency is the ascending colon which is involved only half as often as the two above mentioned sites. All nine cases of appendiceal tuberculosis showed concurrent involvement of the caecum and all nine cases were seen in the far advanced and fibroulcerative cavernous forms of pulmonary tubercu-

Table VI

DISTRIBUTION OF INTESTINAL LESIONS ACCORDING OF TYPE OF CASE

| Segment of G.I. Tract | Clinical Type | | | Pathological Type | | | |
|---|---|---|---|---|---|---|---|
| | M.A. | F.A. | Miliary | C.P. | Fibroid | F.C. | F.U.C. |
| Duodenum | .. | 1 | .. | .. | .. | .. | 1 |
| Jejunum | 1 | 3 | .. | .. | .. | .. | 4 |
| Ileum | 2 | 41 | 2 | 1 | 1 | 3 | 36 |
| Caecum | 2 | 41 | 2 | 1 | 1 | 2 | 37 |
| Appendix | .. | 9 | .. | .. | .. | .. | 9 |
| Colon: | | | | | | | |
| ascending | .. | 21 | 2 | 1 | .. | 1 | 17 |
| transverse | .. | 6 | 2 | 0 | .. | 1 | 3 |
| descending | .. | 7 | 1 | .. | .. | 1 | 5 |

losis. One case presented a tuberculous lesion of the base of the tongue. In one case, adenocarcinoma and tuberculosis resided together in the descending colon; in fact, a nest of cancer cells were observed in the center of a typical tubercle.

Table VII

ASSOCIATION OF INTESTINAL TUBERCULOSIS WITH TUBERCULOSIS OF OTHER ABDOMINAL VISCERA

| Organ | Cases of Intestinal Ulceration | | No Intestinal Ulceration | |
|---|---|---|---|---|
| | Involvement | Non-involvement | Involvement | Non-involvement |
| Spleen | 21 | 26 | 5 | 15 |
| Liver | 21 | 26 | 5 | 15 |
| Kidney | 14 | 33 | 4 | 16 |
| Peritoneum | 4 | 43 | 0 | 20 |
| Mesenteric nodes | 4 | 43 | 1 | 19 |
| Adrenals | 2 | 45 | 1 | 19 |

Forty-five per cent of the cases of intestinal tuberculosis showed tuberculosis of the spleen and liver, and 30 per cent showed renal tuberculosis. Of the cases without intestinal lesions, 25 per cent showed splenic and hepatic tuberculosis, and 20 per cent presented renal tuberculosis.

A minimal severity of the intestinal lesion was noted if the tuberculous process involved only one segment, if the process

did not extend over more than 10 cm. of the segment, or if the ulcers were not more than 1 cm. in diameter. If more than 30 cm. of intestine, or more than two segments were involved, the case was considered severe.

TABLE VIII
ASSOCIATION OF INTESTINAL TUBERCULOSIS AND INTESTINAL SYMPTOMS

| Severity of G.I. Lesion | Clinical Symptoms | No Clinical Symptoms | Total |
|---|---|---|---|
| Minimal | 0 | 3 | 3 |
| Moderate | 7 | 11 | 18 |
| Severe | 13 | 11 | 24 |
| Healed | 0 | 2 | 2 |
| Total | 20 | 27 | 47 |

None of the minimal cases, 40 per cent of the moderate cases and 54 per cent of the severe cases showed symptoms. The most common symptoms were pain, diarrhea, nausea and vomiting.

Four of the moderately severe cases died within five months of the onset of intestinal symptoms. Twelve of the thirteen severe cases died within six months of the onset of symptoms.

TABLE IX
ASSOCIATION OF SEVERITY OF THE LESION TO DURATION OF DISEASE FROM ONSET OF SYMPTOMS

| Severity of Intestinal Lesion | Number of Months from Onset of Symptoms until Death | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | I | II | III | IV | V | VI | VII | VIII | IX | X | XI |
| Minimal | | | | | | | | | | | |
| Moderate | 1 | .. | 1 | 1 | 1 | .. | .. | 1 | 1 | .. | 18 months |
| Severe | 1 | 2 | 1 | 5 | 3 | .. | .. | .. | .. | .. | 23 months |

## SUMMARY

A study is made of the post-mortem findings and certain clinical correlations of intestinal tuberculosis found concurrently in sixty-seven cases of pulmonary tuberculosis.

The cases are from the State Sanatorium, Wallum Lake, Rhode Island.

# A STUDY REGARDING ABDOMINAL ADHESIONS AND OF COTTON AND GAUZE SPONGES

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THE conclusions reached here are based upon 147 laparotomies and autopsies which have been done upon fifty-five animals as well as upon observations in the operating room. The results obtained conform to laws which have been previously expounded, but not sufficiently appreciated. A review of our results also offers some suggestions of possible technical and economic value.

It seems to be the general consensus of surgical opinion that sponging and packing may frequently be responsible for abdominal adhesions, notwithstanding some belief to the contrary. Having had considerable experience, as mentioned later, with cotton dressings, and having observed the use of moistened cotton sponges in abdominal surgery in previous years, we wondered if the softer texture of cotton might make it less irritating to the bowel wall than gauze. We therefore initiated this study. Small moistened cotton pledgets are used at present, as most of us know, in neurologic and eye surgery. The cotton fluff sponge, in which a ball of cotton is wrapped in a thin layer of gauze, has been described. Cotton between layers of gauze is also used as an absorbent dressing. Gauze sponges, however, seem to have completely replaced cotton ones in abdominal surgery.

*Amount of Trauma Necessary to Produce Adhesions by Sponging.* In endeavoring to compare and measure the trauma-producing qualities of cotton and gauze, we tried the following method. A loop of small intestine of the animal selected was laid upon a flat surface covered with sterile cotton or gauze moistened in isotonic saline. The intestinal loop was held taut. A one pound weight around which moistened cotton or gauze had been tautly drawn and tied, was rotated completely six times, the full weight resting upon the loop of intestine selected. This size weight was the heaviest that could be used with the rabbit and cat, without a gross tear of the serosa of the gut resulting. Three or four different gut areas were used in each animal. Also in different areas, the covered weight was moved back and forth three and one-half to four inches for six times. The mechanical trauma produced by this method was much more in proportion than is ordinarily produced in the average abdominal operation, by sponging and packing. As we proceeded and were unsuccessful in causing adhesions, we then stitched the bowel together so that the traumatized areas would be held, not in firm contact, but closely enough together that they would surely approximate at times. In eight animals we were unable to produce, by the above methods, adhesions with either cotton or gauze. It seemed necessary to produce a grossly visible break of the peritoneum for adhesions to form under sterile conditions. Two of the animals used were cats, which are said to be more susceptible than the human to trauma of the peritoneum.

One concurring with the opinion that moderate sponging of the peritoneum may cause adhesions, might be surprised at the amount of vigor with which it is necessary to rub the gut wall in order to produce them. The observations made upon this group of animals enable us to readily agree with Hertzler when he says that "the amount of violence necessary to produce a degree of abrasion sufficient to cause adhesions has been greatly underestimated.

Actual abrasion of endothelium requires considerable violence."

*An Attempt to Simulate the Effects of the Abdominal Pack.* Having come to the experimental conclusion that either gauze or cotton sponges, as they would ordinarily be used, would not alone cause adhesions, attention was directed to the abdominal pack. Conceivably, the length of time which this might remain in contact with the intestine could have something to do with adhesion formation in the ordinary abdominal operation, through causing an exodus of adhesion forming fibrillar fibrin. After some brief experimentation, the area of junction of the small gut with the large was chosen as an experimental site. Accordingly, cotton and gauze pledgets 1.6 × 1.6 × .15 cm., to twice this size, moistened in chosen solution, were stitched to the large gut wall by silk suture upon each side of the small bowel entrance site. We used twelve rabbits, in which the sponges were left two hours and then removed. The abdomens were closed during the two hours the pledgets were in situ. Would the mere contact of the pledgets with the peritoneum for two hours cause adhesions? The animals were reopened in twenty to thirty days. In six of them, the implanted pledgets had been moistened with isotonic saline, in the other six with tap water. In no instance were adhesions at the previous sponge sites demonstrable, with two exceptions. A very few thin ones were present at the sponge sites in two animals, which had eviscerated and contaminated themselves beneath the laparotomy sheet during operation.

Though by this time we had practically abandoned the idea of demonstrating any practical superiority of cotton sponges or packs over gauze ones, as far as adhesion-producing qualities were concerned, we nevertheless decided to implant them for greater lengths of time, intending that after permanent adhesions were produced, the animals might be used for a study of the efficacy of papain solution as a preventive of adhesion reformation.* Accordingly, sponges were attached by the above method in animals for varying lengths of time, and the peritoneal reactions were noted. The results are catalogued in Table 1.

It would not be proper to be too dogmatic regarding the conclusions which we reached from a study of the material listed in this table. We feel, however, that we demonstrated that the degree of irritation left by the gauze pledgets implanted upon the gut wall, was prone to be somewhat more marked than that caused by cotton pledgets under similar conditions. The long fibered cheaper grade of cotton was used in making the cotton pledgets. When these pledgets are moistened and squeezed dry just prior to their application to the gut wall (the same thing applies to this grade of cotton as a wound dressing) they usually detach later as easily as gauze. The pledget tends to come off *en bloc*. An analysis of the table is somewhat difficult. It will be noted that when the time came for removal of the implanted pledgets, it was frequently impossible to withdraw the gauze pledgets without a perforation occurring in the gut wall, from erosion by the gauze pledgets. The cotton pledgets implanted in the same animals gave us little trouble in this respect. When such perforation occurred, it naturally ruined a future reading comparison for the two materials as to their permanent adhesion-producing qualities in the animal involved. We felt that we were justified, though, in assuming in these instances that the gauze had been more irritating than had the cotton; and that adhesions would have been more marked in the gauze areas in these animals had the perforation not occurred. Briefly summing up the observations made on this group, we would simply say that we do feel there was evidence that cotton pledgets implanted upon the gut wall from one to several days were less irritating than were gauze pledgets implanted under similar conditions. We question the present practical value of this finding. It would seem, though, that results from the contact of the mate-

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rials for the varying lengths of time recorded in the table illustrate the damage which may be done by foreign bodies. One can easily visualize the damage which might be done, for example, by a cigarette drain injudiciously used.

*Adhesions from Infection.* In speaking of adhesions from infection which he says, usually disappear in three to nine months, Hertzler states: "The reason these adhesions disappear is that they are formed by a granular fibrin. Such fibrin is incapable of forming adult fibrous tissue and in the course of time is absorbed. As the intensity of the infection abates, the polynuclear cells disappear and the large mononuclears take up the imperfect fibrin. They are unable to absorb fibrillar fibrin, but readily take up the granular form. This property of the various cells gives rise to the general law that the more intense the infection, the more certainly will the adhesions become absorbed."

In the experimental work discussed here, perforation of the large gut was not infrequently done with rather extensive contamination resulting and with recovery of the animal frequently ensuing. In other animals there were perforations with apparently little soiling. We invariably found that permanent adhesion formation was in direct proportion to the amount of contamination which had apparently occurred. This in itself would be insufficient evidence to disprove the general law stated above, but is worth remembering.

*Cotton Base Sponges for Operating Room Use.* Realizing that cotton is much more absorbent than gauze, we decided to have some cotton sponges made for use in the hospital operating room, in order that we might compare their efficiency and economy factors with those of gauze. Sponges similar to the cotton fluff sponges were made. They simply consist of a bit of cotton wrapped in a single layer of gauze, and are approximately rectangular in shape, with dimensions $3\frac{1}{2} \times 2\frac{1}{4} \times 1$ in. Out of an ordinary twenty-three cent roll of long fibered cotton (hospital price) 205 of these sponges are obtainable. Less than one-third as much gauze is used in wrapping the cotton than is used in making

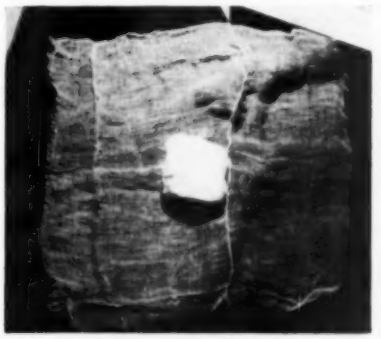

Fig. 1. The cotton base sponge is shown resting in the center of a piece of gauze 15 by 17 inches. In making an ordinary gauze sponge, this large piece of gauze would simply be folded, fringed edges under. This sized piece of gauze will wrap almost four of the cotton base sponges; and it is estimated the latter are 50 per cent to 75 per cent more economical, if properly used, than the gauze ones.

the gauze sponge usually used at our City Hospital. We found that a little less than one-half as many sponges of the cotton type were used on our service than had been used by us on the same type of operations when we had been using the gauze sponges of twice the cost per sponge. The cotton base sponge of size above takes up two full ounces of water before the saturation point is reached, whereas a gauze sponge, costing about the same as one of these sponges, is saturated with one-third ounce of water. These cotton base sponges are easy to handle and give us no difficulty in coming apart. We estimate that if they are used properly, they are about 25 per cent to 50 per cent as expensive as the plain gauze sponges.

We do not suggest that surgical technique throughout the country should adopt the sponges described above. Many surgeons would probably feel it a hardship to do so. But one familiar with the cost of sponging material in a large hospital over a period of a year, can appreciate the saving the percentage mentioned above

would represent. We therefore, to those institutions concerned with strict economy, present this data for anything it may be worth. In the same connection it might be said that the author has for the past several years frequently used cotton sponges moistened in mercuric cyanide solution and then squeezed dry as a dressing material for external wounds, in the clinic as well as occasionally in private practice. This procedure has been satisfactory.

## COMMENT

It is undoubtedly true that not only are the etiologic factors of adhesion formation insufficiently appreciated; but that also the importance of abdominal adhesions has been somewhat overestimated. This does not, of course, mean that we should not continue to attempt to find some harmless method of controlling or preventing their formation. Occurrences of intestinal obstruction from them in themselves, make achievement of the latter desirable. Such a tremendous amount of misdirected investigative work has been and continues to be done, however, that it shows that we have been unable to sufficiently separate the better work from the less desirable; or to appreciate fully fundamentals which have already been proved. Hertzler should be given full credit for his long and laborious efforts on the peritoneum. Our own results, as outlined in this presentation, have increased our respect for his opinions on the subject.

To operate most effectively against the production of abdominal adhesions in the light of our present knowledge, one should do the following things:

(a) Familiarize himself with the behavior of, and different peritoneal reactions produced by, different micro-organisms, realizing that the irritating toxins produced by many bacteria call forth either fibrillar (permanent) or granular (temporary) fibrin, depending upon the number and character of the micro-organisms present.

(b) Avoid as much as possible the introduction of drains or other foreign materials into the cavity, as well as unnecessary trauma in general.

(c) Leave no raw endotheleal edges or surfaces if avoidable; and evert the peritoneal edges as the outside incision is closed. This latter may usually be done, if care is used, with an ordinary continuous whipover stitch, though a Lembert or mattress stitch may at times be advisable.

(d) Be careful in operating to keep the skin and it's edges well covered, and to follow strict asepsis in other ways, in order to prevent the introduction of bacteria onto viscera which have been in long contact with an abdominal pack, or which have in other ways been traumatized.

(e) Keep the patient's water balance properly maintained.

(f) Avoid the introduction of an unnecessary quantity or size, and of unnecessarily hardened suture material. Bury the material when practical.

## SUMMARY

1. Experimental evidence by trauma measurement methods, indicating that sponging and packing as it is ordinarily done in abdominal operations does not alone cause adhesions, is presented.

2. Cotton or gauze pledgets left attached to the gut within the closed abdominal cavity for two hours in an attempt to simulate some of the effects of the abdominal pack, produced no permanent adhesions, except when bacterial contamination was present.

3. Cotton or gauze sponges left attached to the gut for nineteen to thirty hours did not invariably produce permanent adhesions.

4. Cotton or gauze pledgets left for three days or over, almost invariably produced sufficient irritation to cause permanent ad-

TABLE I

| Animal Serial Number | Time Pledgets Left In | Original Reaction to Cotton | Original Reaction to Gauze | Complications | Degree of Permanent Adhesions. Cotton | Degree of Permanent Adhesions. Gauze |
|---|---|---|---|---|---|---|
| 19 | 18 hrs. | x | xx | Died 18 hrs. cause unknown | N.G. | N.G. |
| 14 | 19 hrs. | 0 | x | 0 | 0 | x |
| 25 | 25 hrs. | x | x | 0 | 0 | 0 |
| 15 | 27 hrs. | x | xx | Gut torn in removal gauze | Cotton favored | Cotton favored |
| 24 | 28½ hrs. | x | x | 0 | 0 | 0 |
| 13 | 29 hrs. | 0 | 0 | Killed | | |
| 28 | 30 hrs. | x | xxx | Gut torn in removal gauze | Cotton favored xxxx | Cotton favored xxxx |
| 16 | 3 days | x | xx | 0 | x | xx |
| 18 | 3 days | x | xx | Died 3 days intestinal obstruction | N.G. | N.G. |
| 29 | 4 days | xx | xx | 0 | xxx | xx |
| 30 | 4 days | x | x | 0 | xx | xx |
| 37 | 5 days | x | None used | 0 | xx | |
| 38 | 5 days | x | None used | 0 | 0 | |
| 39 | 5 days | x | None used | 0 | xx | |
| 40 | 5 days | None used | xxx | Gut torn in removal gauze | Cotton favored | Cotton favored |
| 41 | 5 days | None used | xx | 0 | ..... | xx |
| 42 | 5 days | None used | xxx | Some contamination | Cotton favored | xxx |
| 43 | 5 days | None used | xx | 0 | ..... | xx |
| 34 | 7 days | xx | xx | 0 | xx | xx |
| 32 | 7 days | xx | xx | Hole torn in gut by adhesion | N.G. | N.G. |
| 27 | 8 days | xxx | xxx | None | xxx | xxx |
| 33 | 10 days | xxx | xxx | Gut torn in removal cotton | Gauze favored | Gauze favored |
| 35 | 13 days | xxxx | xxxx | Hole torn in gut by adhesion | N.G. | N.G. |
| 31 | 16 days | xx | xxx | Gut torn in removal gauze | Cotton favored | Cotton favored |
| 21 | ? | x | xx | Gut torn in removal gauze | Cotton favored | Cotton favored |

hesions. Occasionally, the pledgets eroded through the gut wall. A study of Table 1 may illustrate the damage that can result from an injudiciously used drain.

5. Some evidence is produced that implanted moist cotton pledgets are less irritating to the peritoneum than gauze ones. At this time, however, we do not consider this observation of practical value.

6. Though we have produced evidence that sponging and packing alone will not produce adhesions, we think it may be possible that sufficient irritation may come from these procedures, particularly that of packing, to enhance adhesion formation by bacteria. We believe, with other investigators, that bacteria introduced into the abdominal cavity at operation, may sometimes cause adhesions, and that great care should be used to minimize their introduction.

Other measures which are prophylactic against adhesion formation are briefly listed.

7. Data regarding the use of a cotton base sponge is presented; and it is felt that hospitals concerned with strict economy might profitably seek the coöperation of their surgical staffs in its use.

The author wishes to acknowledge the courtesy of Miss Daisy Thomson and her operating room force in making the base sponges, and for the spirit of coöperation which they have always displayed in assisting in new or experimental problems.

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# SOME PRACTICAL EXPERIENCES IN THE CONSTRUCTION OF ABDOMINAL SUPPORTS*

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A REVIEW of most of the ready-made abdominal supports shows that there are many faults in the construction of these corsets. Consequently, it may be useful to discuss briefly the basic requirements which such a support must fulfill. Because of the variations in abdominal configuration and the divers purposes for which abdominal supports are prescribed, it is hardly to be expected that a few standard ready-made forms would suffice for a proper fitting in all instances. Therefore, it is preferable to tailor a support by accurate measurements; for even though the cost is higher, the better fit obtained and the longer lifetime of the support outweigh this disadvantage. Furthermore, the most obvious difference between a ready-made and a tailored abdominal bandage seems to be that the latter is made only to fulfill medical indications, while the former is primarily concerned with cosmetic effect. As will be brought out later, the requirements of a therapeutic abdominal support are often opposite to those of a cosmetic one.

The principle indications for the use of abdominal supports are:

1. Pendulous abdomen.
2. Abdominal hernia.
3. Low back pain.

With such marked differences in indication the construction of these supports cannot be uniform. However, there are certain principles common to all types of abdominal bandages.

The contents of the abdominal cavity hang dependently from the spine as a coat on a hook. If the abdominal wall has a cleft, such as a hernia, or is stretched with dilation of the cavity as in pendulant abdomen, the normal mechanism must be repaired by a support. Since the only firm spot in this system is the lumbar and sacral spine, the bandage must be firmly attached to this "abdominal coat hook." Therefore, this portion of the bandage must be made from one piece of material, or if the case requires, it must be sewed together in the vertebral line. To have any lacing at this site is contraindicated. For the same reason, the supporting webbings must not be sewed at the lateral parts of the bandage but united in the vertebral line and embrace the support like a ring.

The abdominal wall and contents have the tendency to fall from posteriorly and superiorly to anteriorly and inferiorly. The fibre of the bandage must follow this oblique direction and be cut so that the warp runs parallel to the line of traction. By this means we achieve a smooth seat; otherwise folds occur, as so often can be seen in badly fitted abdominal supports.

The thicker the abdominal wall the more oblique must be the cut of the textile. This oblique cutting is necessary only for the lower, weight-bearing part of the bandage. The non-weight-bearing portion of the bandage, namely, that part above the apex of the abdominal curve, need not be cut obliquely. Therefore, the upper part of the bandage, usually the upper half, may be cut horizontally or transversely. (Fig. 1.)

In order to support the abdominal wall properly, the lower part and border of the corset must hold the abdomen very firmly. To obtain this prerequisite, the garters must be sewed not at the anterior but at the lateral part of the bandage between anterior and mid axillary line.

The lower border of the support follows Poupart's ligament. If it is too long, a fold

* From the Department of Orthopedic Surgery, State University of Iowa. Service of Arthur Steindler, M.D.

occurs in the inguinal region which injures the skin, especially in maximal hip flexion and sitting position. On the other hand, the tipping we make the support extend quite high on the back. The upper circumference of the corset may be made somewhat

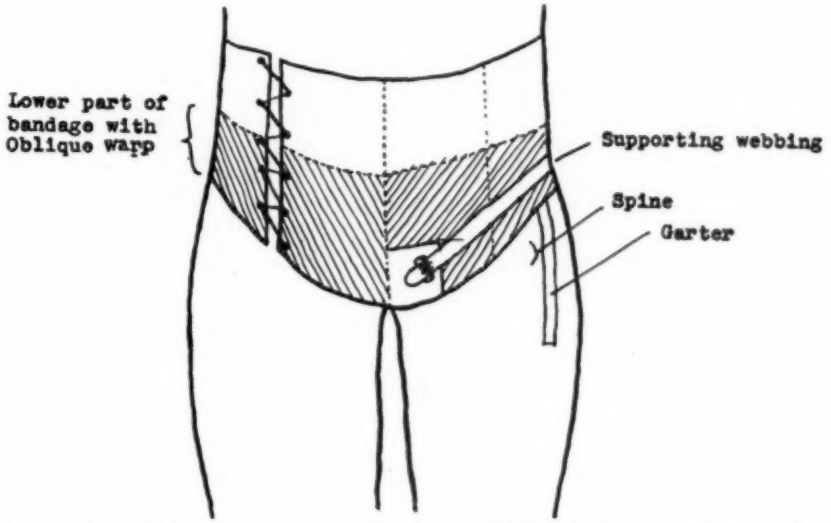


Fig. 1. Nap of lower part of bandage more oblique than course of supporting webbing. Lateral seat of garter. Low convex lower border of bandage. Zigzag arrangement of eyes or hooks.

whole anterior abdominal wall down to the symphysis should be covered. Hence the garment must be cut so that the lower border is convex. A horizontal cut of the lower border is undesirable because it permits an upward sliding of the support and produces folds.

The supporting webbings must have an oblique course and insert at the lowest anterior point of the bandage. (Fig. 2.) Usually, however, their direction is not quite so oblique as that of the lower half of the bandage. The reason is that the origin of the webbing in the back has to be located at the oblique part of the sacrum; otherwise it would slide downward. This means, therefore, that the posterior insertion of the webbing lies a little below the upper margin of the lower portion. The buckles of the supporting webbing have to be sewed at the middle section piece of the bandage nearly at its lower border. They should be fixed exactly at right angles to the course of the webbing; otherwise, folds surrounding the buckles occur.

The larger and heavier the abdomen, the greater is the tendency of the support to tip forward. In order to prevent this larger, thereby avoiding cutting in the fat folds of the upper abdomen; the lower back border of the bandage may be made wider also so that it does not cut in the glutei. Thus the abdominal support assumes a sort of hour glass shape (von Renesse).

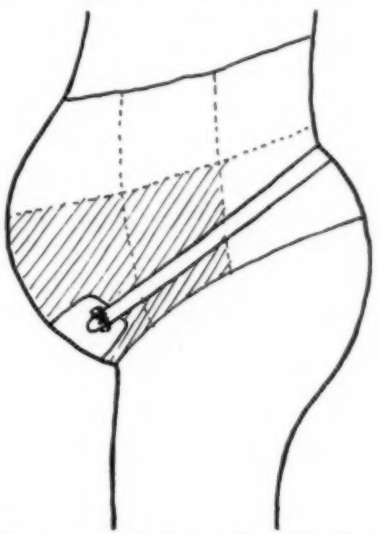

Fig. 2. Insertion of supporting webbing at deepest point of supporting part.

The fewer pieces used in making the bandage, the better it fits. Only one single opening therefore is necessary, preferably

at the left or right side just medial to the anterior superior spine; in case of abdominal hernia the opening should be made on the contralateral side. This opening is closed by laces over hooks or through eyelets. Straps are not desirable because of the unclosed spaces between them. Buttons are inadvisable because they do not permit adjusting the width of the opening. The hooks are to be placed in zigzag fashion, thereby following the oblique direction of the warp. It is necessary to lace upwards in order to elevate the weight of the abdomen. To lace from above downward defeats the purpose of proper weight support. If possible the patient should stand, not sit or lie, while dressing. Furthermore the patient should stand with the abdomen somewhat compressed when measurements are taken. A towel or elastic bandage wrapped around the abdomen facilitates this procedure.

In addition to the foregoing general prerequisites of a good abdominal support as advocated by Lang, von Renesse and others, certain specific features remain to be discussed. As we mentioned previously, the three most frequent indications are for pendulous abdomen, abdominal hernia and low back pain.

For the first condition, pendulous abdomen, no special suggestions are necessary. It is only important to follow closely the above mentioned rules. This refers especially to the oblique cut and the sewing of the supporting webbings at the lowest part. Special pads are always superfluous.

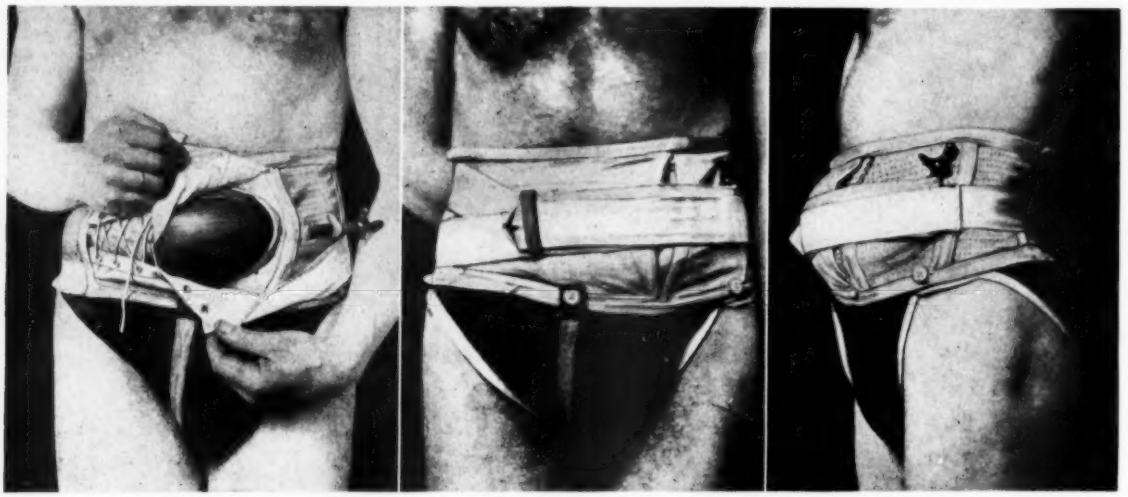

Fig. 3. Fig. 4. Fig. 5.

Figs. 3, 4 and 5. Bandage for abdominal hernia with pneumatic pad.

The second indication, abdominal hernia, usually requires a pad to hold back the hernial sac. The pads are most often made from solid material, as wood, celluloid plate, fibre plate, or aluminum sheet. For large hernias, however, particularly for post-operative hernias of the median line, the alternating filling and emptying of the bowel causes discomfort to the patients, since the solid pad cannot be adjusted so easily or exactly. For such purposes I described a pneumatic pad in 1929, using football or soccer-ball bladders; these are available in different sizes. The former is employed when the hernial aperture is oval, the latter when it is round. (Figs. 3, 4, 5.) In some cases with long narrow apertures a colpeurynter bladder affected good closure. The patients inflate these bladders after putting on the corset. When the support feels too tight, for instance after meals and otherwise, they open the valve and the air can escape. This support with pneumatic pad for abdominal hernias has been used in many cases and has proved its worth.

In mild cases of low back pain as well as during or after gravidity, we use abdominal

corsets with a pad in the lumbo-sacral or sacral region. Based on the idea that a relaxation of the pelvic ring and particularly of the sacroiliacal joint causes pain, the purpose is to support this ring. Therefore such a garment has to hold the enlarged pelvic ring together very tightly and furthermore to support the lower spine (Goldthwait). Both requirements are fulfilled by a small abdominal support and a sacral pad closely applied to the sacral curvature. In many cases, however, a small abdominal belt is not sufficient, when the pain is seated near the coccygeal region. In such cases the pad should be placed very low, but the corset itself must extend quite high on the back to prevent tilting and upward sliding. Sometimes one or two perineal straps are indicated. The sacro-coccygeal pad should be covered with rubber to prevent soiling.

The purpose of the previously described rules based on experiences of a close coöperation between physician and corsetiere for many years is to bring out the importance of such a collaboration. It is, therefore, advisable that the surgeon acquires the technical knowledge which enables him to prescribe in detail a proper support; by so doing he will obviate the many faults and deficiencies of a poorly constructed or improperly fitted garment.

SUMMARY

Abdominal supports are indicated for the pendulous abdomen, abdominal hernias, and low back pain. The construction varies with the difference in indication. Most of the ready-made corsets show certain standard forms which aim primarily at the cosmetic affect. The tailored abdominal support on the other hand is constructed accurately to fulfill the therapeutic requirements of the case. Among the rules for the construction of such supports may be mentioned the oblique course of the fibres of the lower part of the bandage but the horizontal course of the upper portion, the convex shape of the lower border following Poupart's ligament, and the hour-glass shape of the support.

For abdominal hernias, the author described in 1929 a support with a pneumatic pad, using football or soccer-ball bladders. By inflating these bladders or opening the air-valve, the pressure of the support can be regulated.

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# MAJOR LOWER EXTREMITY AMPUTATIONS IN THE AGED POOR-RISK PATIENT

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ON any busy surgical service the question frequently comes up as to whether or when to amputate in the bad-risk, aged individual with arteriosclerotic or diabetic gangrene. The condition of the patient and the risk depend a great deal on the individual's economic and social status, so that the group in which we are particularly interested is usually found in the municipal hospitals.

This article is primarily a discussion of a difficult group of cases at the City Hospital, New York City. The group consists of fifty-seven consecutive cases, representing all the major amputations of the lower extremity at the City Hospital during the last five years. For comparison, during this same period of time, all major amputations of the lower extremity, fifteen in number, at the Beekman Street Hospital, New York City, are also being studied. The Beekman Street Hospital is a so-called voluntary or private hospital, and may thus be compared with the City Hospital, a charity or municipal institution.

It has been known since the time of Hippocrates and Celsus[1] that the risk of major extremity amputations is great. Two of the greatest feats in surgery as late as the beginning of the eighteenth century were the guillotine amputation of Nelson's arm n 11797,[2] and the first successful hip joint amputation by Walter Brashear of Kentucky, in 1806.[3] The mortality rate in all major amputations is high, but in the aged poor-risk group with lower extremity gangrene it is so high that some surgeons question the advisability of any major procedure. We will attempt to determine by this study whether, when and how we should operate upon these people. All the amputations in the two institutions named are considered here in the statistical study, but we are primarily interested in the mortality, indications for operation, and the technique to be employed in the aged poor-risk group.

The following is the detailed statistical report and study of fifty-seven cases of major lower extremity amputation at City Hospital, and fifteen cases at the Beekman Street Hospital for the five-year period ending April 1, 1936.

## CITY HOSPITAL

The 57 cases were managed on the services of six attending surgeons, with the greatest number on any one service 23 and the lowest, one. There were sixteen different operating surgeons who did from 1 to 12 of these amputations each, with an average of 3.5 cases. There were only four surgeons with 5 of these operations or more to their credit. Some of the cases were accredited to the resident surgeons with one of the attending surgeons as assistant. This demonstrates that these procedures were distributed among many operators, and that, with few exceptions, they did not have the opportunity to do enough cases to become proficient in this particular work at this particular hospital. Musser[4] of Akron, Ohio comments in this regard, "The busiest of us perform fewer than ten major amputations a year," with a "painfully large number of unsatisfactory results."

There were 44 males, or 72.2 per cent, and 13 females, or 22.8 per cent. It was noted that 9 of the 13 females were diabetics. Forty-eight patients were white (84 per cent), 9 were colored (16 per cent).

No significance was found in the color of the patients.

Age varied from 9 years to 86 years with an average in all cases of 57.4 years. The average, omitting those under 40, was 61.6 years. The average age of 38 arteriosclerotic and diabetic patients was 65.1 years. The average age of the 19 cases in which the etiology was other than arteriosclerosis or diabetes was 41.9 years.

The age frequency in twenty-year periods was as follows:

| Age | Cases | Percentage |
|---|---|---|
| Up to 20 | 1 | 1.8 |
| 20 to 40 | 6 | 10.5 |
| 40 to 60 | 22 | 38.6 |
| 60 to 80 | 26 | 45.6 |
| Over 80 | 2 | 3.5 |

The etiology in 49 cases or 86 per cent was some form of gangrene. Osteomyelitis was the cause in 5 cases; trauma alone in 2 cases, and thrombosis post partum in 1 case. We are particularly interested in the gangrene cases, whose specific etiologies were as follows: Arteriosclerosis was the origin in 18, constituting 37 per cent of the gangrene cases or 32 per cent of all cases. Included in the 18 arteriosclerotic gangrenes, is one associated with trauma, one associated with aneurysm and one associated with thrombosis of the femoral artery. Diabetic gangrene was responsible for 18, 37 per cent of the gangrene cases or 32 per cent of all cases; thromboangiitis obliterans in 8 cases, 16 per cent of the gangrene cases or 14 per cent of the total number. Five gangrenes were due to other causes (10 per cent of all gangrenes or 9 per cent of all cases); lues was the origin of two; trauma of one; frost-bite of one; and one followed pyarthrosis of the knee.

The etiologies of the 5 osteomyelitis cases were as follows: following trauma, 3; associated with squamous cell carcinoma of stump, 1; associated with tuberculous arthritis of the knee, 1.

Spreading gangrene was the most common indication for amputation, being present in 42 cases or 73.6 per cent, of which 23 showed noticeable infection. Other indications for amputation were: demarcated gangrene, 3; osteomyelitis alone, 5; trauma, 3; pain alone, 1; for plastic repair, 1; for non-healing stump, 1; for osteomyelitis and carcinoma, 1. Pain was mentioned as one of the indications in 9 cases. In the diabetic cases McKittrick and Root[5] point out that any patient who has a cold, pulseless foot, with infection, is a likely candidate for septicemia, much more so than when the pulse is palpable. A normal temperature, they add, does not rule out this danger. A major amputation is therefore indicated, and any delay is dangerous.

Many surgeons have studied the circulation of the extremity in relation to indication for amputation, site of amputation and prognosis. Stewart[6] divides circulatory disease of the extremity into two elements:

1. The spasmodic element under control of the sympathetic nervous system, in which sympathectomy may be of value.

2. The organic element affecting the vessel wall.

Veal[7] describes arteriography as one more safeguard for the patient with gangrene of the extremity and states that injection of a solution of thorium dioxide into the femoral artery, followed by *x*-ray of the extremity, shows: (1) the presence of arterial occlusion; (2) the size of the large arteries above and below the knee; (3) the number of the muscular and skin branches with their size and distribution; and (4) the efficiency of the collateral circulation.

McNealy and Shapiro[8] state that the primary element in the amputation decision is an estimate of the circulatory status of the limb. Carter[9] states that in diabetics, the presence of infection, its duration, its extent, its cause of general reaction, its location and its rapidity of increase should determine the immediate procedure more than any other single factor. In traumatic cases Heller[10] usually operates immediately and states that it is not necessary to wait until all shock is gone before amputating. Da Costa[11] states in reference to senile gangrene that if it affects only one or two

toes, the dead parts should be allowed to be cast off spontaneously, but if a greater area is involved, or the process spreads, amputation should be done above the knee without waiting for a line of demarcation. In regard to the age and incidence of gangrene in diabetics, Joslin[12] declares that the average age of the development of diabetic gangrene is 62 since gangrene is an accompaniment of arteriosclerosis, which is common in diabetics of five or more years' standing. Gangrene is seldom seen in young diabetics or soon after the onset of the disease. Joslin therefore considers that, "Procrastinating medical methods do more damage than prompt surgical intervention. The chief tack of the medical or surgical consultant is to bring to an end dangerous delays and secure action." With regard to the essential vascular factor in these cases, Buerger[13] states: "A study of the condition of arteries and veins in limbs amputated for so-called diabetic gangrene reveals the fact that in each and every instance we are dealing not with a gangrenous process due to diabetes *per se*, but with a mortifying process dependent upon extensive arterial disease."

In our present series, 30 cases, or more than half of the total, had had some preliminary operation or operations; 58 procedures had been carried out in all, the most common being amputation of the toes. Other preliminary operations in the 30 cases are indicated in the preceding table:

| | No. of Cases |
|---|---|
| Incision and drainage of abscess | 7 |
| Amputation of toe or toes | 14 |
| Amputation of foot | 1 |
| Disarticulation of ankle | 1 |
| Amputation below the knee | 6 |
| Amputation of thigh | 2 |
| Other leg or thigh amputations | 5 |
| Amputation of arm | 1 |
| Closed reduction with sutures | 1 |
| Open reduction | 1 |
| Débridement | 2 |
| Crushing of nerves | 1 |
| Plastic operations | 2 |
| Curettage | 1 |
| Biopsy | 2 |
| Arthrodesis | 1 |
| Sequestrectomy | 2 |
| Aneurismorrhaphy | 1 |
| Injection of sympathetic nerves | 3 |
| Resection of nerves | 1 |
| Lumbar ganglionectomy | 1 |
| Periarterial sympathectomy | 2 |

The final operation was thigh amputation in 49 cases, or 86 per cent. Of these, 41 were mid-thigh operations, while the rest include:

| | No. of Cases |
|---|---|
| Upper third of thigh | 1 |
| Lower third of thigh | 5 |
| Disarticulation of knee | 1 |
| Upper third of leg | 4 |
| Middle third of leg | 0 |
| Lower third of leg | 3 |

Considering that most of these patients are of the poor-risk type and that most of them are in a sense emergency operations, it would seem that these amputations should be done with all reasonable speed. It is interesting to note the extreme difference in time of operation in apparently similar cases. In 13 operations there is no record made of the time, while in the remaining 44 the shortest time taken was ten minutes and the longest eighty minutes, with an average of thirty-five minutes. Twenty-one cases or 47 per cent were operated upon in thirty minutes or less, while in 23, or 72.7 per cent, the operation took *more than twenty minutes*. The list of the times of operations in ten minute periods is as follows:

| Time in Minutes | No. of Cases |
|---|---|
| 0–10 inclusive | 2 |
| 11–20 | 9 |
| 21–30 | 10 |
| 31–40 | 9 |
| 41–50 | 6 |
| 51–60 | 4 |
| 61–70 | 3 |
| 71–80 | 1 |

Major Williams,[14] operating in a Soldier's Home where the average age for amputation was 72, advocates a speedy guillotine operation. I believe these cases should all be done in *less than twenty minutes*. It would be noted from the foregoing that 72.7 per cent of the cases in our study required more than twenty minutes.

Another plausible factor in lowering the mortality is anesthesia. The great variance in the type of anesthetic used will be noted in the following table.

| Anesthesia | No. of Cases | Per Cent |
|---|---|---|
| Spinal alone | 18 | 32 |
| Local | 1 | 1.7 |
| Anesthesia not recorded | 3 | 5 |
| No anesthesia | 1 | .7 |
| Inhalation | 34 | 59 |
| Gas oxygen | 4 | |
| Ether alone | 2 | |
| Ethylene alone | 12 | |
| Gas oxygen and ether | 12 | |
| Gas oxygen, ether and ethylene | 2 | |
| Ethylene and ether | 1 | |
| Gas oxygen and ethylene | 1 | |
| Spinal and ethylene | 1 | |
| Rectal evipal and gas oxygen | 1 | |

I believe spinal anesthesia is contra-indicated in the old age poor-risk group, and that the majority of the inhalation anesthesias are unnecessary for a short operation. Gas oxygen alone is in my opinion, adequate and by far the safest method to use, although in this series it was employed in only 4 cases. McKittrick and Root[5] believe that gas is the anesthesia of choice, as does Kirk.[15] Da Costa[11] advises avoiding ether and chloroform and recommends the use of nitrous oxide with oxygen and ethylene. Joslin[12] prefers ethylene or gas oxygen.

The various techniques mentioned were:

| Method of Operation | No. of Cases |
|---|---|
| Formal amputation with layer closure. | 15 |
| Guillotine flap | 32 |
| Through and through sutures | 21 |
| Drains specifically mentioned | 37 |
| Layer sutures | 29 |
| With packing of wound | 10 |
| Gritti-Stokes | 2 |
| Operations without tourniquet | 2 |
| Amputation associated with inguinal node dissection | 1 |
| Transverse guillotine without flaps | 6 |
| Transverse guillotine without flaps with electric knife | 1 |
| Disarticulation of knee with suturing of skin | 1 |

The guillotine flap amputation is a rapid operation with either long anterior flap and short posterior, or vice versa, or both flaps long. The flaps are made with a single motion of the knife, starting from within distally through all layers, above and below the bone. The bone is amputated high up and the flaps closed over the stump loosely with through-and-through sutures. This is the operation of choice. As Musser[4] states; "the term guillotine, although sanctioned by usage, is a misnomer, as the limb is not divided by a simple transverse cut, but is removed with the formation of a shallow inverted cone whose apex is the divided bone end."

Beverly Smith[16] advocates the guillotine-suture operation of the lower third of the leg in early cases. Jaffe and Pomeranz,[17] in discussing the proper site of amputation, brought out in a micropathologic study of bones, the fact that sclerosis and potential osteomyelitis may be present high above the gangrenous area, in spite of a normal *x*-ray appearance. Eloesser[18] advises exarticulation through the knee for decrepit people who will probably not wear an artificial leg, while Callander[19] describes a new and much more elaborate amputation of the lower third of the thigh, using the patella, somewhat similar to the Gritti-Stokes technique. Many observers have attempted to determine the correct site for amputation, but Burke and Meyerding[20] of the Mayo Clinic studied 102 cases of amputation in thromboangiitis obliterans without establishing any criteria for determining a site.

The post-operative morbidity in our series varied from zero days in a patient who died on the day of operation to one year and ten months. The average was 74.8 days. In the 31 fatal cases, the post-operative morbidity varied from zero days to 455 days with an average of 51.4 days; 8 died on the day of operation or on the following day.

The most important consideration in this study is the mortality. Of the 57 cases, death occurred in 31, a mortality rate of 54.39 per cent.

Considering the arteriosclerotic and diabetic patients sixty years old or over, of whom there were 27, 20 died, a mortality

of 74 per cent. All the arteriosclerotics and diabetics together, totaled 37, of whom 27 died, a mortality of 73 per cent. Arteriosclerotics alone were 19 in number, of whom 12 died, or 63 per cent. Diabetics alone numbered 18, of whom 15 died (83 per cent). The twenty remaining cases were of other than diabetic or arteriosclerotic etiology, and of these 3 died, a mortality of 15 per cent. These cases may be further broken down as follows:

| Cause | No. of Cases | Mortality | Per Cent |
|---|---|---|---|
| Trauma | 2 | none | none |
| Osteomyelitis | 5 | none | none |
| Thromboangiitis obliterans | 7 | 2 | 28.6 |
| Other | 6 | 1 | 16.7 |

The listing of the causes of death as given on the hospital records is not particularly significant, as most of the deaths were undoubtedly due to multiple factors referred to previously as the old age poor-risk group.

McKittrick and Root[5] reported an operative mortality of 17 per cent in diabetic patients following amputation for gangrene of the lower extremity. They stated that fully 50 per cent of the deaths could be attributed to delay in treatment with resulting septicemia. McKittrick and Pratt[21] in an extensive study, found a mortality in 326 major amputations of 15 per cent, in which 32 of the 57 deaths, or 56 per cent, were due to infection. Joslin[12] gives us some pointed comments in regard to the mortality in diabetic gangrene, saying that, "the surgical diabetic requires six times as much attention as the medical diabetic, because he is six times as likely to die." and that "one-half of the surgical deaths in the past were due to septicemia." He writes that there is an immediate operative mortality of about 25 per cent, and that patients dying within a few days of operation do so because the operation was performed too late; that "death from gangrene today is usually the result of procrastination on the part of the physician and patient. Surgery often receives, but seldom deserves the blame of a fatal issue."

A not uncommon and extremely serious complication of amputation of the lower extremity is gangrene due to one of the gas-producing baccilli, notably B. welchii or B. coli. Many observers have warned against this, in particular Cabot[22], Orr,[23] Meyerding,[24] and a special committee on the subject from the Hospital for Joint Diseases in New York.[25] They all stress the importance of careful preparation of the extremity and the importance of avoiding contamination from the patient's stool and from the infected gangrenous area, both of which regions have been proven to harbor gas-producing organisms.

Many other complications were noted, but none are of particular significance for this study.

### BEEKMAN STREET HOSPITAL

There were 15 cases of major lower extremity amputation at the Beekman Street Hospital during the same five-year period covered by the City Hospital study. These 15 cases were managed on the services of five attending surgeons. There were six different operating surgeons who did from one to four amputations, with an average of 2.5 operations for each. None of the surgeons operated in more than four cases.

There were 11 males (73 per cent), and 4 females (27 per cent). Fourteen patients, or 94 per cent, were white, the remaining one being colored. The age of the patients varied from 7 to 68 years with an average of 42.86 years. This is noted as appreciably lower than the average at City Hospital. The age groups were:

| Age | Cases | Per Cent |
|---|---|---|
| Up to 20 years | 2 | 13 |
| 20–40 | 5 | 33 |
| 40–60 | 4 | 26 |
| Over 60 years | 4 | 26 |

The etiology in this series is quite different from that at City Hospital, since trauma and infection are the predominant factors.

| Etiologic Factor | Number | Per Cent |
|---|---|---|
| Trauma alone | 7 | 47 |
| Trauma with gas bacillus infection | 1 | 7 |
| Embolism | 3 | 20 |
| Osteomyelitis | 2 | 13 |
| Diabetes alone | 1 | 7 |
| Diabetes with arteriosclerosis | 1 | 7 |

Indications for amputation were found to be quite different from the other group, as was to be expected from the etiology. Spreading gangrene, the most common indication at City Hospital, was mentioned in only 3 cases. Various preliminary operations were done in 8 cases, all being associated with trauma. There were no amputation of toes. Final operation was a thigh amputation in 8 cases and amputation at or below the knee in the remaining 7.

The time of operation showed tremendous variation from 7 to 105 minutes, with an average of 37 minutes. In 8 of the cases the operation took less than 30 minutes; in 7, it took 30 minutes, or longer.

Spinal anesthesia was used in 6 cases and inhalation anesthesias in 9. The anesthetics other than spinal were gas oxygen, ether, avertin, gas oxygen and ether, avertin and gas oxygen, ethyl chloride and ether. It was noted that gas oxygen alone was used in only one case.

The pre-operative morbidity is also entirely different from the City Hospital record, being from 1 to 33 days with an average of 9.6 days. This is due to the preponderance of traumatic cases. The post-operative morbidity varied from 1 to 244 days with an average of 51 days. There was an average of 5.9 days of post-operative morbidity in the fatal cases.

The mortality rate was 46.6 per cent, as 7 of the 15 died. The average age of the fatal cases was 51 years. In the 5 patients of 60 or more, all died.

## SUMMARY

1. Seventy-two cases of major lower extremity amputation, seen in two hospitals over a period of five years were studied. Of the fifty-seven cases at City Hospital most were of the old age, poor-risk type with arteriosclerotic or diabetic gangrene, operated upon by many different surgeons, using many methods and a large variety of anesthetics.

2. Ages between 60 and 80 were most frequent.

3. Mid-thigh was the most frequent site of amputation.

4. The general mortality was 54.4 per cent at City Hospital and 46.6 per cent at Beekman Street Hospital.

## CONCLUSIONS

In spite of the discouragingly high mortality, it is my opinion that these cases, even the poor-risk, old age group, should be operated upon. If the following suggestions, based on this study and upon the experience gained through operation upon nearly one-fourth of the studied cases, are followed, the mortality should be appreciably less:

1. Avoid procrastination on the part of the medical, metabolic, circulatory, surgical or other specialist, as well as delay due to the patient or his family.

2. Bear in mind early in the case that amputation may become indicated, and prepare the way by having the patient in the best possible condition and by obtaining the proper authorization, so there will be no delay at the crucial time when delay adds to the risk.

3. The more experienced the surgeon in this particular type of case, the lower the mortality rate.

4. Indications for major amputation are: gangrene spreading beyond the toes; gangrene with spreading infection; gangrene with or without infection if accompanied by intractable pain.

5. Most favorable site for amputation: mid-thigh.

6. Speedy operation, i.e., under twenty minutes, is advisable.

7. Gas oxygen is the anesthesia of choice.

8. Technique: guillotine flap without tourniquet, with through-and-through sutures and drain.

The following pre-operative routine has been instituted during the past few months at City Hospital for my cases of this type:

MAJOR LOWER EXTREMITY AMPUTATIONS

Preparation for Operation

Plenty of fluids.
Electrocardiograph.
Chest *x*-ray.
*X*-ray of extremity.
Blood grouping.
Urinalysis.
Blood pressure.
Chest examination.
Special preparation for diabetic cases in conjunction with the metabolic service.
Usual local preparation: sterile towels left on and only removed in operating room. Dressings on infected or gangrenous areas *not* to be removed. They are to be covered with sterile towels.
Morphine sulphate gr. ¼
Atropine sulfate gr. 1/150
} One hour before operation except in diabetics.
Infusion of 5 per cent glucose in saline to be started in operating room fifteen minutes before operation and continued as long as necessary after operation in ward. Citrated blood transfusion may be added to this.
Anesthesia: gas oxygen only, anesthetist not to add anything else without specifically asking the surgeon.
Anesthesia not to be started until leg is draped.
*No tourniquet*
Simple drape so that extremity may be manipulated quickly.
Second assistant in charge of manipulating leg.

Instruments, Etc.

Hot pads only (no sponges).
1 amputation knife.
1 straight Mayo scissors.
1 saw.
12 large Kocher clamps.
3 #3 plain catgut needles.
#2 catgut ties.
8 heavy tension sutures (all ready before operation), on large skin needles.
2 plain rubber drains.
Dressings and leg roll.

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"The medical man has to remember that he cannot see behind the abdominal wall, and cannot clinically differentiate between catarrh, which may well subside, and an obstructive appendicitis or one with a stercolith in the lumen, which will inevitably lead to disaster."

"No one wishes to decry the importance of fever [in appendicitis], and usually there is no need to do so, but its absence must not allay doubts and give a sense of security in the presence of other clinical signs and a definite history."

"Internal fistulae [in appendicitis] must follow the opening of an abscess into other parts, such as the cecum, small bowel, rectum, vagina and bladder. They close naturally."
From—"Appendicitis. A Clinical Study," by W. H. Bowen (Macmillan).

# BREAST DEFORMITIES

## ANATOMICAL AND PHYSIOLOGICAL CONSIDERATIONS IN PLASTIC REPAIR*

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### INTRODUCTION

SUCCESSFUL plastic repair of the female breast demands complete familiarity with the anatomy and physiology of the structures involved. The interstitial or epithelial hyperplasia of a hypertrophic breast may signify a precancerous condition or early malignancy whose surgical treatment is entirely different from the correction of a benign hypertrophy. An accurate differential diagnosis must therefore be made in every case presented for plastic reconstruction. This is impossible without full knowledge of the evolutionary and functional changes the mammary structures undergo. In this paper a few anatomical and physiological points are considered with respect to the etiologic factors in mammary deformities and the choice of surgical procedures for their repair.

### PHYSIOLOGY

*Embryonic Development.* Traced from its embryonal origins, the breast first appears as an epidermal ridge extending from the axilla to the groin. Certain points of this ridge are thickened, forming the mammary glands. When the so-called "milk spots" (which are believed to derive from the sweat glands) develop unduly, accessory breasts appear at different points on the site of the epidermal ridge. (Figs. 1 and 2.)

*Infancy.* At birth the breasts consist of epithelial columns without lumens, but they soon undergo change. The ducts assume definite cylindrical form and a milky fluid may be produced. These characteristic alterations occur in boys as well as girls. The process is completed during the first or second week of life and the epithelium returns to a quiescent state. Until puberty there is no further change. The gland measures about 2 cm. in diameter and 1 cm. in thickness.

*Puberty.* At puberty the female breast begins to develop, reaching adult form and proportions within a varying period of time. The normal breast is made up principally of connective tissue, with comparatively little fat and glandular structure. This gives it a characteristic resilience. At this period of life, the breast is usually a firm hemisphere which varies little with change of position, for the connective tissue bands which control its form have not yet sustained the repeated congestions produced by mammary function. (Fig. 3.)

In addition to function and age, individual, hereditary and racial characteristics—manifested in the proportion of fat, fibrous, epithelial and glandular elements—play an important role in determining the size and consistency of the breast. When fibrous tissue predominates, the organ is firm. It is soft and pendulous in the presence of excessive fatty tissue.

*Pregnancy and Lactation.* Omitting the periodic changes of menstruation (when the tissue is oedematous, the fiber thicker and the epithelium becomes taller and stains more deeply) the next great alteration in the breast occurs during pregnancy. Its volume increases, especially after the third month, and the functional growth of the gland causes a diminution in fibrous tissue, with the result that the breast loses its hemispherical form. The skin covering is stretched and may show distension scars (striae) similar to those which appear on the abdominal wall.

* From the Department of Plastic Surgery, Sydenham Hospital, New York, N. Y.

With lactation there is a further increase in volume and weight; the breast becomes still more distended and the tendency to

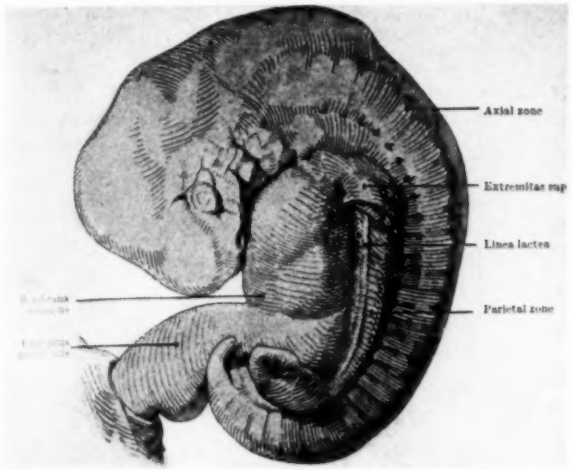



Fig. 1. Human embryo, showing epidermal ridge from which derive the mammary glands. (Kollman.)

pendulousness is heightened. As function ceases, a retrogression of glandular tissue occurs, but the pendulousness frequently remains because of the inability of the skin and supporting ligaments to regain their former elasticity. This is particularly true after repeated pregnancies, the extent of the process varying with the individual.

*Senility.* The final senile involution of the breast, in which the glandular structure disappears, begins at the menopause. As a rule, this involution involves the skin, fat and fibrous tissue as well as the gland. The result is a small, atrophic mamma. (Fig. 4.)

## ANATOMY

The breast is projected on the chest wall between the third and seventh ribs. Laterally it lies between the axillary and parasternal line.

*Fixation.* At the end of puberty, as already stated, the breast is composed chiefly of fibro-elastic tissue with a small amount of glandular structure, the whole surrounded by a more or less developed fatty capsule. A two-fold fixation is provided by the skin and the retro-mammary fascia.

The skin covering the youthful breast is usually thin and free from wrinkles. Unlike the dermal covering elsewhere on the

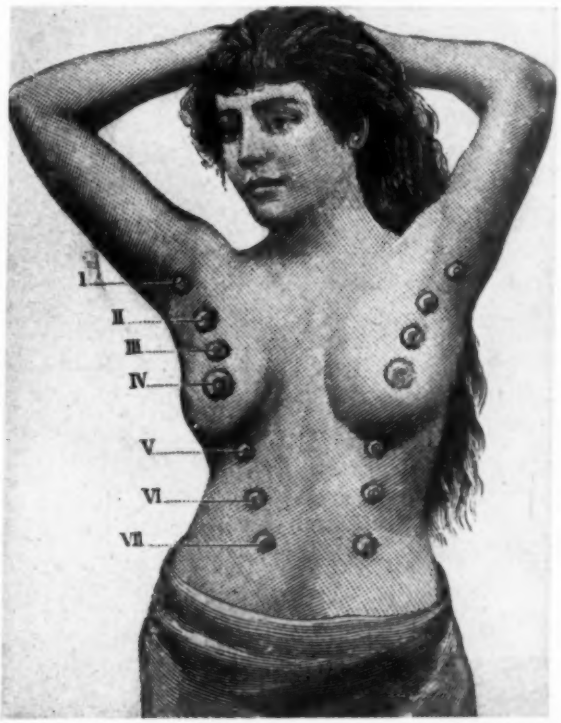



Fig. 2. Topography of supernumerary breast glands. (Williams.) IV, the normally placed nipple. Those located above and below are the correspondingly superior and inferior supernumerary nipples.

body, it is firmly adherent to the underlying structures, due to multiple fibrous prolongations into the gland. These connective tissue septa, which are known as Cooper's ligament, surround the lobules of the gland and extend to the skin. (Fig. 5.)

The skin acts as an apparatus of fixation in two ways. Its fibrous prolongations into the gland create a real suspension of the breast, and, by encircling the fatty masses, limit their development.

At its deeper surface the gland is in contact with the fascia covering the pectoral muscle, but the connection is not a direct one. Between the two lies a thin fibrous layer a few millimeters thick. This is covered on the glandular side by a very thin fascia which continues toward the clavicular bone, on which it is suspended. There is great individual variation in the development of the retro-mammary fascia,

which is known as the suspensory ligament of the breast. Giraldes believes that this ligament, which forms a part of the superficial thoracic fascia, continues from the clavicula to the upper border of the gland, where it divides into two layers forming a sort of capsule about the anterior and posterior glandular surfaces. In any case, while the retro-mammary fascia may contribute to the support of the breast, the skin remains the more important factor in mammary fixation. (Fig. 6.)

It is not surprising that a marked increase in weight or excessive pressure on the breast should overtax the fixation apparatus and cause pendulousness. The loose connection of the gland with the retromammary fascia explains the easy mobilization of the breast on the thorax. As soon as the youthful preponderance of elastic fibrous tissue is diminished by an increase in gland or fat—as happens in pregnancy, glandular hypertrophy or general adiposis—the fixation apparatus gives away. The breast loses

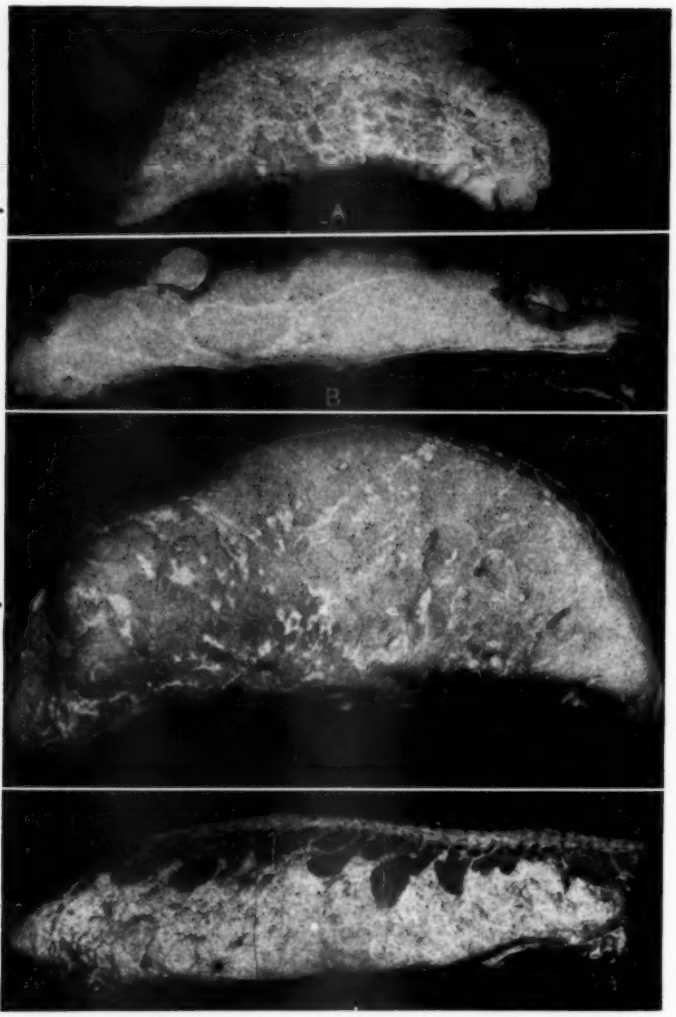



Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. Cross section of the two different types of normal mammary gland. A, fibrous tissue very abundant. The breast gives the impression of a tumorous mass suggesting fibrosis. B, large areas of fat encircled by strands of connective tissue. On palpation, the breast feels like a large pad of fat.

Fig. 4. Section of a senile breast. All that remains of parenchyma are thin fibrous septae and atrophic acini.

Fig. 5. Ligaments of Cooper-strands of fibrous tissue, shown in light gray, extending from breast proper to skin.(Hertzler.)

its firmness and one or another type of deformity is seen. Mammae that are richly supplied with fibro-elastic structures are

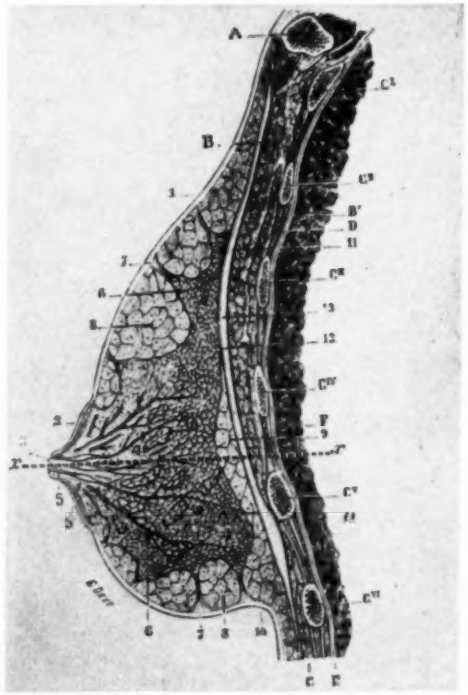


Fig. 6. The retromammary fascia which, together with aponeurosis of the great pectoral muscle, forms the suspensory ligament of the breast. *XX*, horizontal level of the nipple corresponds to the fourth intercostal space. (Testut.)

frequently provided with good elasticity of the skin too: such breasts retain their form in spite of repeated pregnancies, lactation and advanced age. Conversely, anemic and asthemic young women frequently display small, pendulous, ptosed breasts because of a congenital weakness of the suspensory apparatus and insufficient fibro-elastic structures in the skin.

In reconstructing the mammae, it is not permissible to rely on the skin alone to retain the reduced organ in place and preserve its form. Cases that come to surgery almost invariably present either a constitutional inelasticity of the skin or a distension from lactation or adiposis. The normal fibrous prolongations into the gland are defective. Even after redundant skin has been excised, the remainder cannot be expected to provide a firm support for the breast.

This was already understood in early attempts at plastic repair when Girard attached the gland to the second intercostal

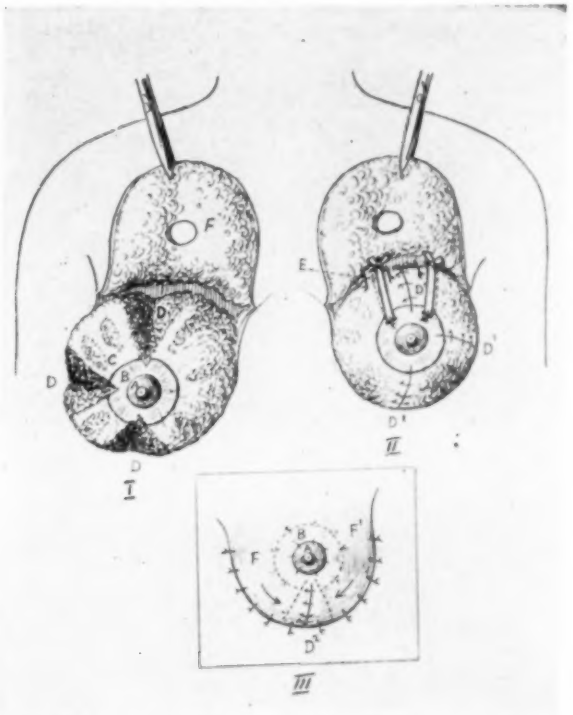
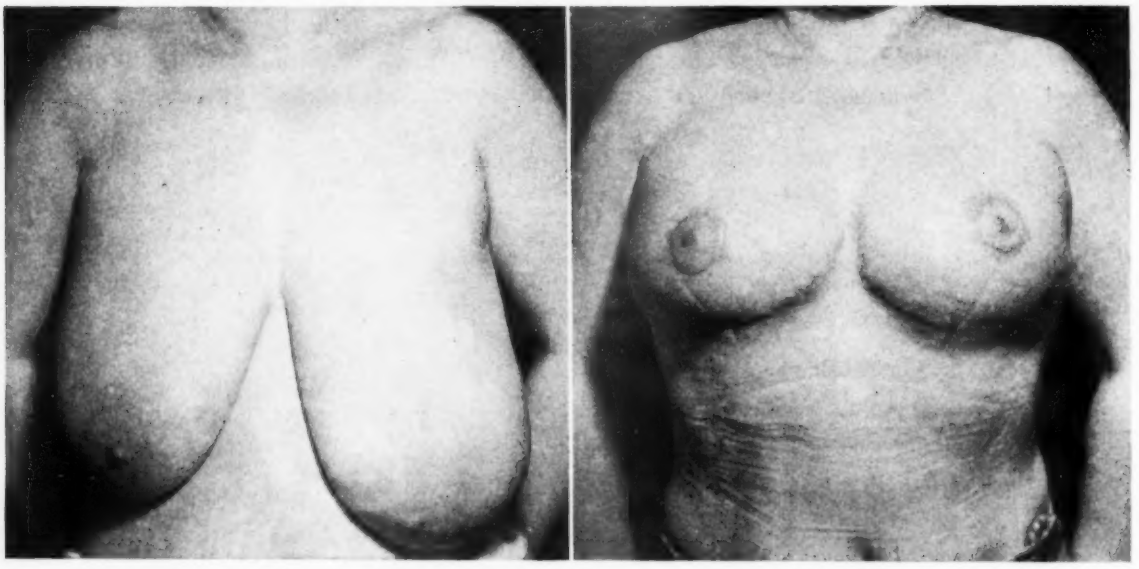


Fig. 7. Mastopexy by means of dermal loops. The uniformly reduced breast is affixed to the pectoral fascia. I B, circular fragment of derm obtained through removal of epidermis from corresponding part of skin. D, excised areas of breast tissue. F, flap showing button hole where transposed areola is sutured in. II, D-L, closure of breast defects. E, loops extending from periareolar derm to pectoral fascia. These loops are obtained from discarded breast skin following removal of epidermis. III, final result. A, transposed areola and nipple sutured in button hole. B, dermal graft placed subcutaneously (dotted line circle) assuring central fixation of breast. $D^2$, suture line in lower quadrant following excision of excessive skin. F-$F^1$, skin flap sutured in submammary fold.

space by means of fascia loops.[1] Although his method goes further than necessary, it recognizes the need to have the gland affixed to the pectoral fascia in simulation of the normal. We accomplish this by mastopexy to pectoral aponeurosis by means of dermal strips. The subcutaneous affixation in simulation of the Cooper's ligament is done. The affixation to the skin is brought about in transposing the areola together with a large area of derm. (Fig. 7.)



A B

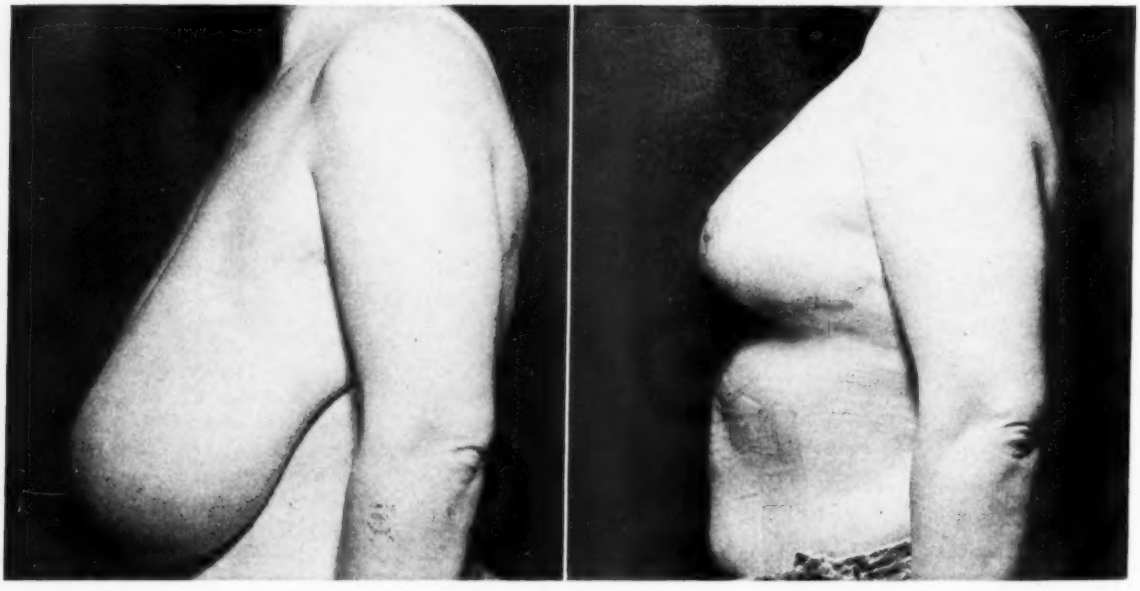


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FIG. 8. Woman, aged 37, with asymmetrical hypertrophic, pendulous breasts. Rapid growth of both breasts, especially the left one, followed two pregnancies. Palpation revealed small, freely movable lumps in both breasts, some of which were about the size of an egg. There were two large masses in the external quadrant of left breast which extended from its central portion toward the axilla. Note that left breast is about one-third larger than right. Plastic repair done in two stages. In first stage simultaneously with transposition of nipple, all encapsulated tumors were removed from both breasts. The two large masses removed from left breast were cystic fibromas weighing 690 Gm., and measuring respectively 13.5 by 15 and 11 by 11.5 cm. On section the tissue was white and homogenous in appearance, feeling fibrous and hard. Numerous cystic fibromas were removed from right breast, among them one cyst which weighed 72 Gm. and of same structure as the cysts of left breast. Amount of tissue removed in second stage from both breasts, 390 Gm.

Histology revealed marked hyperplasia, hypertrophy of breast acini and considerable hyperplasia of ducts.

*Gland and Nipple.* The gland itself is composed of approximately sixteen to twenty primary ducts extending downward and outward from the nipple. At a short distance from the latter, these ducts are dilated, forming ampullae; they are lobulated at the end. The increased size of the breast during lactation is produced by normal development of the lobules, oedema of the connective tissue and increased circulation. (Fig. 6.)

The nipple, which is formed of muscle fibers and connective tissue, varies with the individual. Usually it is cone-shaped and reddish-white in color. On contracture of its circular muscle fibers, it is capable of elongation.

The surrounding areola is covered with small elevations caused by the glands of Montgomery. The pinkish areolar skin, which darkens in pregnancy, is of extremely fine texture and adheres to the underlying smooth muscular structures without the interposition of fatty tissue. It is highly important to avoid injury to this muscle, when the areola is incised, as it controls the nipple's erectility.

In reducing the gland, the central portion should be left intact for two reasons. For one, the blood supply follows the ducts toward the nipple. For another, the main ducts should be preserved to retain some degree of function, even if there is not sufficient for lactation. Normal function does not exist in most breasts which come to surgery, particularly where there is fatty or fibrous degeneration. It cannot be expected after the removal of a large amount of fatty and glandular structure. However, some function may persist in the main, central portion of the gland and it should be preserved if possible.

Where hypertrophy of the breast is due to exuberance of glandular structure, a pathological process exists which may border on malignancy. In such cases the safest procedure is to excise the gland. Following removal of excessive skin, a free graft of the nipple is made to simulate the missing breast.[2] Fortunately, this condition is rare and such drastic surgery is neither necessary nor suited to the repair of other mammary deformities.

*Blood Supply.* No factor is more essential to successful surgical reconstruction of the breast than preservation of an adequate blood supply. The topographical distribution of the latter is therefore of the utmost importance in determining surgical procedure.

The breast derives its blood supply from three sources: (1) the thoracic lateral artery (branch of the axillary artery) (2) the internal mammary artery (branch of the subclavicular) and (3) perforant branches deriving from the third to the seventh intercostal arteries.[3]

The thoracic lateral is the largest of these. Penetrating the lateral hemisphere with two or three perforant branches, it irrigates the skin and external half of the gland, but does not furnish any circulation to the nipple. The internal mammary, which penetrates the internal half with two branches, derives great importance from the fact that it supplies the central portion of the gland and the nipple. The group of perforant branches originating in the intercostals, penetrates the intercostal muscles and also supplies the deep and central portions of the gland, though to a lesser extent than the internal mammary. As there is little anastomosis between these various arteries, the main blood supply must be carefully preserved in each part.

The veins in the breast, which assume the same distribution as the arteries, terminate in the axillary veins. They are often dilated and form a subcutaneous plexus. The lymphatics with which the mammae are so richly supplied also terminate in the axillary region.

From the foregoing it is seen that, contrary to a commonly held opinion, the main blood supply of the nipple, areola and central portion of the gland is derived from penetrating branches of the internal mammary and intercostals and not from the thoracic lateral, whose branches supply

the external half of the gland and the skin. In a few of the author's cases, large quantities of glandular structure were removed from the external quadrant without impairing the "take" of the nipple in any way.

The distribution of the blood supply explains how excision of the external half of the breast, done in some procedures can be carried out without interference with the circulation of the nipple. Although the branches of the thoracic lateral are necessarily sacrificed, the circulation to the papilla remains intact.

It is important to proceed with great care in the excision of fatty and glandular structures in the area of the nipple and areola. The circular incision in the areola which our procedure requires should be superficial, so as not to injure the underlying circular muscle fibers or interfere with the surrounding vascular plexus. It should be emphasized, however, that this circular incision around the areola does not in any way endanger the circulation to the nipple.[3]

In sclerotic, fibrous breast, where small cystic fibromas or adenomas compress the interstitial spaces and in all probability greatly reduce the blood supply, the excision of large amounts of breast tissue may entail too great a sacrifice of the blood supply and endanger the nipple. In fatty infiltration of the breast there is not as much interference with the blood supply and considerable excisions can be made with less risk of necrosis. The removal of cone-shaped sections from the mammary structures and closure of the resultant defects reduce the horizontal diameter of the breast and result in a firm, protruding hemisphere. (Fig. 7.)

*Surgical Procedure of Choice.* Whenever large amounts of fat and glandular tissue must be removed, the risk of interfering with the blood supply exists. To minimize this the author has employed for many years a two-stage procedure. The nipple is transposed with most of the blood supply intact and secondary resection is postponed until after the "take" of the central portion of the gland is complete.[4]

This does not complicate or prolong the repair to any extent. Aside from the risk of necrosis, it is contraindicated to perform a complete reconstruction of two breasts in one stage. Speed is not the primary consideration where form and symmetry and the avoidance of scars are essential elements in a good end-result. Since a one-stage operation must be highly protracted to accomplish all of these aims, it is more advisable to employ the two-stage procedure, which removes all risk to the blood supply and lessens the operative strain on the patient.

## SUMMARY

Fixation of the breast is provided by the skin through multiple fibrous prolongations (Cooper's Ligament) into the gland and by the retro-mammary fascia which provides a suspensory ligament attached to the clavicula. A marked increase in the weight of the breast, from any cause, overtaxes this apparatus and produces ptosis.

In mammary reconstruction, the transposed gland should be firmly attached to the pectoral fascia to simulate normal fixation. This is done by means of a circular row of non-absorbable sutures, which must not be permitted to involve large amounts of gland or fat.

In reducing the gland, the central portion should be left intact to preserve the blood supply to the nipple and to retain such function as exists in the main central ducts. In glandular hypertrophy of the breast, a rare condition bordering on malignancy, the entire breast gland should be removed.

Circulation in the breast is derived from: (1) the thoracic lateral, which supplies the external half and skin; (2) the internal mammary, which is the principal source of supply of the internal half, including the central portion of the gland and the nipple; and (3) several perforant branches of the intercostal arteries which also supply the deep and central portions of the gland.

There is little anastomosis between these, so the main blood supply must be carefully preserved in each part.

Since the thoracic lateral does not supply the nipple, the large amounts of glandular structure may be removed from the external quadrant without impairing the "take" of the transposed nipple. Great care must be taken in the excision of excessive fat and glandular structures in the area of the nipple and areola. Although the circular incision in the areola does not endanger the blood supply it should be superficial so as not to injure the underlying circular muscle fibers or interfere with the surrounding vascular plexus.

As the blood supply comes through the deep portion of the gland, there is always risk of interfering with the blood supply when large quantities of fat and glandular tissue must be removed. The author employs a two stage procedure to minimize this risk. The nipple is transposed with most of the blood supply preserved and secondary resection is postponed until after the "take" of the central portion of the gland is complete.

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"A great variety of organisms have been demonstrated in Hodgkin's glands, but that there is a causative relationship is wholly unlikely. We are still at the point of beginning. If the disease is of infectious origin we are ignorant of the identity of the offending organism."
From—"Surgical Pathology of the Diseases of the Neck," by Arthur E. Hertzler (Lippincott).

# "BLOODLESS" CESAREAN SECTION

R. L. GORRELL, M.D., D.N.B. AND F. L. WILSON, M.D., F.A.C.S.

CLARION, IOWA STUART, NEBRASKA

AS contrasted to the great majority of surgical procedures, the cesarean section appears crude. Free bleeding occurs, which is very difficult to control until the delivery has taken place. Amniotic fluid pours out over the incision, often into the peritoneal cavity.

Preventable blood loss is not good surgery. The puerperium is lengthened and resistance to infection lessened. Approximation of the uterine wall is made more difficult, especially in the thin lower uterine segment, by the continuous oozing.

Amniotic fluid results in a sterile peritoneal reaction, with post-operative distension and elevation of temperature.

Methods of control of bleeding as used at present are these:

1. Compression of uterine walls.
   (a) De Lee[5] temporarily compresses the margins of the uterine incision with long, light intestinal forceps, then follows with allis forceps for individual bleeding points, until sutures can be placed.
   (b) Bickham[4] suggests pressure on each side of incision by gauze pads, preceding delivery. If serious hemorrhage follows, the uterus may be lifted up and compressed between the hands of an assistant while through-and-through sutures are being inserted.
2. Packing the uterine cavity.
   (a) Montgomery[7] has suggested packing of the uterus combined with pressure from the outside.
   (b) Hirst[8] states, "bleeding may rarely need to be controlled by packing."
3. Compression of uterine blood supply. The uterus may be lifted out-side of the abdomen and the broad ligaments compressed between the assistant's fingers,[7] or between rubber covered clamps.[4]
4. Suture of uterine wall.
   (a) "The greatest possible irritation of the uterine muscle is the insertion of the necessary sutures."[8]
   (b) Many surgeons "make no special preparation, but by working expeditiously, realizing that the bleeding will continue until the uterus is empty and contracts, when serious bleeding will usually cease, and that it cannot contract until emptied of it's contents."[4]
5. Prophylactic measures.
   (a) A uterine incision of ample length, so that no tears will result from extraction of the baby.
   (b) Slow delivery of the infant, permitting the uterus to contract properly.
   (c) Allowing sufficient time for separation of the placenta (which usually occurs within one to six minutes.)[9]
   (d) Where indicated, a "test of labor." Diekmann and Daily[9] have found that the average blood loss during an elective section was 624 c.c., as contrasted to 256 c.c. which were lost after labor had been in progress over ten hours. Also, of course, the test may indicate that a normal delivery may be possible. The amount of bleeding is less, "because the lower uterine segment is more at-

tenuated, the vessels are compressed and the uterus is more irritable, thus contracting more rapidly after delivery."[9] After labor has been in progress, the vesicouterine peritoneum is stretched and loosened, permitting easy peritoneal reflection for the laparotrachelotomy.

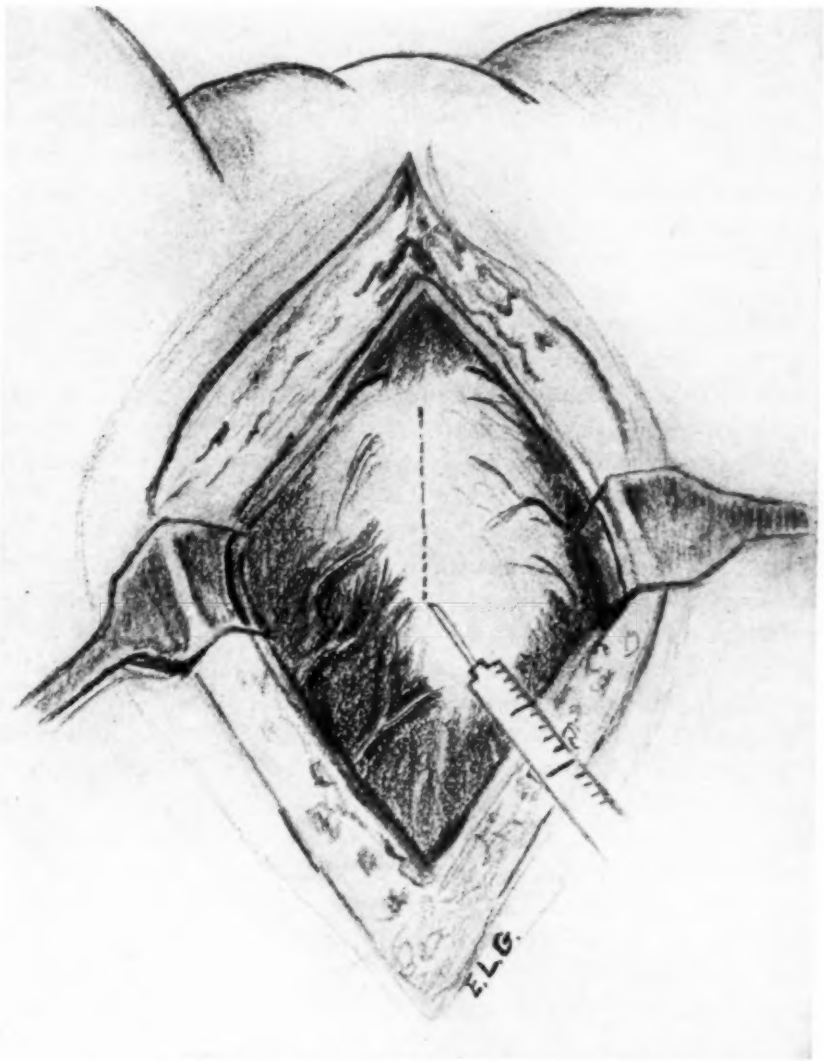


Fig. 1. Injection of pituitrin along the line of uterine incision.

6. Massage of uterus.
7. Subtotal hysterectomy for uncontrollable bleeding (and septic, of course), especially for uteroplacental apoplexy. Slemons[11] reports two cases of severe post-operative bleeding, one fatal. In the fatal case, a previous incision had left a wide, thin scar which was not excised. The second case presented uterine apoplexy six hours after a normal section. Hysterectomy was necessary to control exsanguinating hemorrhage.

Slemons' summary is interesting; "Post-partum hemorrhage after cesareans should result from only one of the three familiar causes of post-partum hemorrhage (laceration, retained placental fragments, atony) i.e. atony. Atony is increased because of the deeper, prolonged anesthesia (local or spinal anesthesia would prevent this). Imperfect suturing of

the uterine incision incurs an additional risk of hemorrhage, especially where the incision passes through the placental site. Inaccurate approximation may leave open a sinus, divided at operation, and oozing will continue until thrombosis stops it or death intervenes."

8. Pituitrin and ergot preparations.
   (a) Injected subcutaneously or intramuscularly.[1,3,5]
   (b) Injected intravenously: Heffernan[10] has reported 100 laparotrachelotomies. Five-tenths c.c. of pituitary extract is diluted by 3 c.c. of warm, normal saline solution, and injected into elbow vein when the peritoneal flaps are being reflected. "Firm, immediate contractions of the uterus are of distinct advantage . . . If the uterus remains flaccid and boggy, free bleeding occurs from the incision, obscuring the operative field and depleting the patient." The left hand is slipped under the baby's head, maintaining cephalic flexion—the firmly contracting uterus, occasionally aided by pressure on the upper abdomen, forces the head through the uterine incision. No instruments to rotate or extract the head are needed.
   (c) Injected into uterus
      (1) At random into body of uterus.[1,2,5]
      (2) Along line of proposed incision. It is this last technique which we wish to present. It is not even mentioned in any of the standard works on obstetrics or surgery, although not original with us.

      The uterus is exposed and surrounded with gauze packs to wall off the peritoneal cavity from contamination. If a classical section is to be done, an ordinary syringe of Luer type is filled with 5 cubic centimeters of obstetrical pituitrin, a No. 22 needle 3 inches in length fitted on, and the pituitrin injected subperitoneally along the line of incision. Areas of blanching appear at once, and the incision may be made immediately. Two c.c. are used if a low cervical cesarean section is to be done. Here, the injection is done after the peritoneal flaps have been raised.

      To one accustomed to working in the usual flow of blood, the relatively avascular field is enjoyable, permitting as it does a slow, careful delivery and accurate approximation in layers, without haste. There has been no accurate check on the amount of blood lost, but visiting physicians have estimated that there is less than one-half of the bleeding usually seen.

      By the time suture is complete, the pale areas have become almost normal in color. Where an additional procedure, such as tubal sterilization, is carried out, the incision appears perfectly normal at the end of that time.

(d) Diekmann and Daily suggest that "pituitrin should be injected into the uterine muscle after the head of the infant is delivered, and then after two or more minutes the remainder of the baby should be slowly extracted. Thus the uterine muscle will have time to accommodate itself to the tremendous decrease in size of the cavity, and the amount of hemorrhage will thereby be lessened."

Is there a real necessity for the control of bleeding during sections? Diekmann and Daily[9] after careful measurements at the University of Chicago Clinics have found that the average loss is 538 c.c. with a range from 170 to 1,410 c.c. "The amount of blood which may be lost in a cesarean section performed by an experienced surgeon is amazing. None of the staff realized that the blood loss was more than 700 c.c. in seven out of twenty operations." (This does not include post-partum bleeding.) Thus, many patients lose the amount of blood that is given during an ordinary transfusion. And all this at the hands of experienced surgeons. What about the operator who does a section once in six months, often without adequate equipment or help?

What are the disadvantages of each type of hemorrhage control? Clamping the uterine sinuses has the obvious disadvantage of filling the operative field with forceps, thus preventing adequate approximation without their removal. Death of uterine tissue may follow clamping. Through-and-through suturing would seem to predispose to a very weak uterine scar. Packing the uterus should probably be reserved for a real emergency, because of the danger of rubbing infection into the walls. Compression of the broad ligaments between the assistants fingers seems to offer real possibilities in temporary control of hemorrhage. There is the very real drawback that in lifting the uterus out of the abdominal cavity, shock may follow, due to suddenly decreased intra-abdominal pressure. Clamping the broad ligaments with rubber-covered clamps while simple and feasible, might result in damage to the intima of the veins, with thrombosis and possible pulmonary embolus as a fatal complication. Rapid suture of uterine wall may result in poor approximation of layers, a weak scar and post-partum hemorrhage. Intravenous pituitrin would seem to be very effective, but until it had been used in a larger number of cases, the questions of systemic effects, uterine tetany and fetal asphyxia cannot be answered. Pituitrin injected into the uterus itself would seem to be the most logical procedure, and there seems to be no reason why it should not be used in the line of incision. The possibility of anemic necrosis of the uterus along the line of infiltration has not been substantiated by observations made on reoperation, nor made of the uterus after some minutes have elapsed. Because the incision is made into the pituitrin-infiltrated area directly, much of the solution is quickly liberated and the total dose is not over-large.

Twenty-five sections have been done on our service in the last five years, all with this technique. Spinal anesthesia was used in all cases (novocaine crystals, 150 mgm.). The low cervical section was used in five cases. Ages of patients ranged from 17 to 48. Two were reoperations. Forty per cent ran a temperature of 100° or more for two days, which just about equals the figures for sections done with the usual technique. In a number of these cases, however, complications were present. The infants were in good condition.

1. Mrs. A. W., primipara, age 22, weight 224 pounds; generally contracted pelvis. Low cervical section was followed by temperature of 100 to 100.9° for five days, due to superficial infection in subcutaneous fat. Convalescence entirely normal otherwise, with normal lochia.

2. Mrs. F. K., para 7, age 42; previous pregnancies and deliveries had been entirely spontaneous. After twelve hours of hard pains,

the head was still unengaged, the cervix dilated three centimeters, and abdominally the presentation seemed to be shoulder. Low cervical section was followed by much distension but elevation of temperature persisted for only thirty-six hours. (100.4° F.)

3. Mrs. H. K. age 18, primipara, contracted pelvis. After 22 hours in labor without engagement of the head, a laparotrachelotomy was performed with this technique. A ten pound infant was delivered. Convalescence was uneventful; temperature never over 100°.

4. Mrs. S. H., age 36, secundipara, previous section and tubal sterilization desired. Classical cesarean done one week before term. Blood loss estimated at 250 cc. Temperature 100° two days, then to normal. Lochia normal.

This series is too small to draw sweeping conclusions, but it is hoped that others will try this technique.

## SUMMARY

Pituitrin is infiltrated beneath uterine serosa in line of proposed incision. Bleeding is reduced very markedly, resulting in faster, better suturing and lowered blood loss to the patient.

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# GENITOURINARY TUBERCULOSIS*

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IN this study of the postmortem findings in seventy-five cases of tuberculosis or allied disease, the number is too small to warrant definite conclusions. However, coupled with similar series, it may be of some value.

Of the seventy-five cases, sixty-seven were pulmonary tuberculosis. There were five cases of non-tuberculous chest disease and there were two cases of extrapulmonary non-tuberculous disease, including a renal cancer. A case of tuberculosis of the vertebra was included and one case of pulmonary tuberculosis had an antecedent lesion of the hip. In this entire series, forty-one cases presented renal pathology other than a passive congestive reaction, and all forty-one cases were associated with some form of tuberculosis. The distribution of the cases of pulmonary tuberculosis according to age and sex is shown in Table 1. Table 1A shows the distribution according to age, sex and clinical diagnosis of the forty-one cases showing renal pathology. In general, the distribution is the same in both tables.

Pathologically, the 6 M.A. and 61 F.A. cases showed 2 cases of miliary disease, 1 caseopneumonic process, 2 fibroid cases, 6 cases of fibrocaseous disease and 56 cases of fibroulcerative cavernous tuberculosis.

Both cases of miliary tuberculosis showed renal tuberculosis. Miliary disease of the contralateral lung was seen in a fibrocaseous process and a fibroulcerative case, showing renal tuberculosis. Terminal contralateral tuberculous pneumonia was observed in a caseopneumonia and a fibrocaseous lesion, both with renal tuberculosis. A fibroulcerative process terminated in a similar manner. Tuberculosis of the spine and of the hip (associated pulmonary lesions) accounted for two other cases with tuberculous kidneys. In all, there were eighteen cases of tuberculosis of the kidneys. The association of kidney pathology and the type of disease is shown in Table 11.

TABLE 1

| Sex | Age | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0–9 | 10–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | 70–79 | Total |
| Male... | 1 | 3 | 7 | 11 | 15 | 8 | 3 | 1 | 49 |
| Female. | 0 | 5 | 5 | 2 | 3 | 1 | 2 | 0 | 18 |

TABLE 1A

| Far Advanced | Age | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0–9 | 10–19 | 20–29 | 30–39 | 40–49 | 50–59 | 60–69 | Total |
| Sex: Male.... | 1 | 3 | 5 | 5 | 6 | 4 | 2 | 16 |
| Female..... | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 18 |

MODERATELY ADVANCED: TOTAL, 3: FEMALE, 26 YEARS; MALE, 44 AND 75 YEARS

TABLE 11

ASSOCIATION OF KIDNEY PATHOLOGY TO TYPE OF DISEASE

| Type | Kidney Pathology | | | |
|---|---|---|---|---|
| | Miliary Tbc | Amyloid | Degenerative | No Change |
| Miliary..... | 1 and 1* | 1 | 1* | 0 |
| Caseopneumonia..... | 1 | .. | .. | 0 |
| Fibroid..... | .. | .. | 1 | 1 |
| Fibrocaseous..... | 1* | .. | 1 and 1* | 4 |
| F.U.C..... | 14 and 1* | 3 | 12 and 1* | 25 |
| Assoc. Pneumonia.... | 2* | .. | 1* | 0 |
| Clinical M.A..... | 1 | 1 | 1 | 3 |
| F.A..... | 17 | 3 | 18 | 26 |

(* indicates that the case is also listed under other types of pathology also. Ex. Fibrocaseous disease with miliary termination.)

It was observed that all cases presenting renal tuberculosis, showed either ulcera-

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tive lesions of the lungs or terminated with miliary or pneumonic processes. The association of renal pathology with tuberculosis of other abdominal viscera is noted in Table III.

TABLE III

| Kidney Lesion | Cases of Tuberculosis of | | | | |
|---|---|---|---|---|---|
| | Liver | Spleen | Adrenal | Intestines | Nodes |
| Tuberculosis | 14 | 13 | 2 | 14 | 3 |
| Amyloid | 2 | 1 | 0 | 4 | 0 |
| Degenerative | 4 | 6 | 1 | 14 | 2 |
| No Change | 6 | 6 | 0 | 15 | 0 |

In one case with a diffuse amyloidosis of the abdominal viscera, the pancreas was involved.

Intimations of an association between pleural complications of pulmonary tuberculosis and the dissemination of the disease to the genito-urinary tract suggested a study of this relationship.

Nineteen of the sixty-seven pulmonary cases showed pleural complications in the form of cellular effusions, empyema or pyopneumo-thorax. Twelve of these cases presented kidney damage, as shown in Table IV.

TABLE IV

| Kidney Lesion | Pleural Complications | |
|---|---|---|
| | Present | Absent |
| Miliary Tbc | 6 | 12 |
| Amyloid | 0 | 4 |
| Degenerative | 6 | 13 |

In all 19 cases, the pleural contents contained tubercle bacilli. However, none of the six cases with renal tuberculosis presented a tuberculous bacilluria.

A consideration of approximately 200 clinical cases under pneumothorax therapy, revealed forty-two patients with pleural effusions of which thirty-six contained tubercle bacilli. The urine of twelve of these thirty-six cases showed tubercle bacilli either on smear or guinea pig inoculation. Characteristically enough, in the three cases in which the smear was positive but the guinea pig inoculation was negative, all patients were females. Catherized specimens were negative on smear.

A study of the microscopic urinary findings of these twelve clinical cases with a tuberculous bacilluria, revealed the fact that they had a rather persistent and increasing number of pus cells in the urine. After extrarenal genitourinary infection had been ruled out, this persistence and especially the increasing severity of a pyuria was found to be an effective, though crude, method of anticipating the extension of the pulmonary pathology to the kidneys before a bacilluria is detected. It is not inferred that the presence of tubercle bacilli in the urine indicates a demonstrable tuberculous renal lesion nor is it to be inferred that the absence of a bacilluria rules out renal tuberculosis. However, a study of urinary findings may suggest incipient disease.

Twenty-two of the sixty-seven cases of pulmonary tuberculosis presented a pyuria. Of the eighteen cases showing renal tuberculosis, eight had a pyuria and only three cases presented tubercle bacilli in the urine. However, it was noted that all cases with a pyuria showed some kidney pathology and if there was no renal tuberculosis, either the liver or spleen showed tubercles.

The duration of the pyuria from its inception to the detection of a bacilluria was determined in the twelve clinical and the three autopsy cases. More than half of the cases showed a positive smear in six months.

TABLE V

DURATION OF PYURIA UNTIL THE DETECTION OF BACILLURIA IN SUSPECTED RENAL TUBERCULOSIS

| | Months Duration | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Number of Cases | 0 | 0 | 0 | 5 | 1 | 2 | 0 | 1 | 1 | 1 | 2 | 0 | 2 |
| | | | | Total 8 | | | | Total 5 | | | | | |

More than half of the cases with pyuria and presenting a bacilluria, showed a positive smear within six months. None of them were of longer duration than thirteen months.

Finally, a series of ten cases is listed in which there was disease of the associated extrarenal genitourinary viscera. Nine of these are tuberculous lesions and one is malignancy.

I. Male, 45 yrs., F.A.B. and fibroulcerative cavernous (F.U.C.). Tuberculosis with renal tuberculosis showed lesions of the pelvic epithelium, ureters, bladder and prostate. No pyuria.

II. Male, 33 yrs., F.A.B. and F.U.C. with renal tuberculosis showed tubercles in the pelvis and ureters. There was an empyema and tuberculosis of the liver and spleen. No pyuria.

III. Male, 36 yrs., F.A.B. and F.U.C. with renal tuberculosis showed prostatic tuberculosis. Pyuria.

IV. Male, 26 yrs., caseopneumonic and F.A.B., showed tuberculosis of the testis. There was only passive congestion of the kidney, but the liver and spleen contained tubercles. No pyuria.

V. Male, 27 yrs., F.A.B. and F.U.C., with renal tuberculosis showed tuberculosis of the testis. Pyuria.

VI. Female, 30 yrs., F.A.B. and F.U.C., with renal tuberculosis showed tuberculosis of the Fallopian tubes. Pyuria.

VII. Female, 39 yrs., F.A.B. and F.U.C., showed tuberculosis of the ovaries and Fallopian tubes. There was an empyema and pyuria.

VIII. Female, 17 yrs., F.A.B. and F.U.C., with no kidney lesions, showed tuberculosis of the ovaries and tubes. There was tuberculosis of the liver. Pyuria.

IX. Male, 41 yrs., F.A.B. and F.U.C., with amyloidosis of the kidneys, showed tuberculosis of the testis.

X. Female, 42 yrs., showed a hypernephroma of the left kidney with bilateral metastases to the lungs. The case had been referred to the State Sanatorium with a diagnosis of renal tuberculosis based on the finding of acid fast bacilli in the urine. Guinea pig inoculation was negative. There was a pyuria.

It is noted that those cases of tuberculosis of the excretory tract (ureters, bladder and prostate) had associated renal tuberculosis. One of the three cases of tuberculosis of the testis had renal tuberculosis; a similar ratio was noted for tuberculosis of the ovaries and tubes. None of the cases presented a bacilluria and the pyuria was of little correlative value.

## SUMMARY

The genitourinary pathology of seventy-five cases of pulmonary tuberculosis and allied diseases was studied. The relation of renal tuberculosis to urinary findings failed to show a clear cut association between a tuberculous bacilluria and the renal infection. Pleural complications of pulmonary tuberculosis as a disseminating agency to the kidneys was not observed.

# RENAL INFARCTS*

## A SURGICAL ASPECT OF BACTERIAL ENDOCARDITIS

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THE condition under consideration is aseptic renal infarcts, a lesion which, because of the difficulty in recognizing it, frequently leads to surgical errors.

Many surgeons must, at some time, have experienced the chagrin of operating for a condition which definitely appeared surgical only to discover that an aseptic renal infarct was present, complicating some obscure systemic disease. Such embarrassment is sometimes shared by the clinician, who not only requests surgical consultation, but confirms the necessity for surgical intervention.

The septic infarct most commonly secondary to a cutaneous infection and which usually terminates in a perinephric abscess, or occasionally in a carbuncle of the kidney, will not be included in this discussion. The latter is a well known surgical entity which usually occasions but little difficulty in recognition but may nevertheless tax the surgeon's diagnostic acumen and surgical judgement. The timely recognition and proper surgical management of this renal condition is not only curative, but may shorten an otherwise long and protracted illness.

This paper concerns itself with a general discussion of aseptic renal infarcts, particularly those complicating subacute bacterial endocarditis as illustrated in the five cases reported in this paper.

It is not my purpose to discuss subacute bacterial endocarditis, but rather to emphasize that in some cases this well understood and usually easily recognizable heart lesion may be so obscured by embolic renal lesions, which are rather common, as to mimic an acute primary intraperitoneal or renal disorder. This occurred in four of our ninety cases of bacterial endocarditis. The many interesting clinical phases of bacterial endocarditis are thoroughly discussed in the contributions by Libman, Clawson, Baehr, Bell, Thayer, Loehlein and Blumer. Clawson in a study of 220 cases of bacterial endocarditis found gross renal infarcts in 26 per cent and microscopic lesions in 55 per cent. Bell found microscopic lesions in 52 per cent. In 150 autopsies, Blumer found renal infarcts in sixty-four cases. In two of these the infarcts were septic. The spleen, lungs, brain and extremities are also common sites of embolic lesions, particularly the first organ.

Aseptic or non-suppurative renal infarcts may occur in a variety of conditions, although according to our clinical and post-mortem records bacterial endocarditis and chronic cardiac lesions are the predominant etiologic factors. Barney and Mintz, in an excellent monograph on the subject of renal infarcts, reported several cases and reviewed autopsy records of 143. In only six of these was a normal heart found; bacterial endocarditis and chronic valvular changes predominated. Aschner collected sixteen cases of renal infarcts and reported two associated with chronic valvular lesions of the heart. Another etiologic factor in the production of non-suppurative renal infarcts as we have noted at post-mortem, was atherosclerosis of the aorta or renal vessels. In another case, renal infarcts had their origin in a thrombophlebitic vein of the lower extremity; thrombi had broken away and passed through a patent foramen ovali to lodge in both kidneys. A thrombus was also arrested at the bifurcation of the aorta where it formed a saddle back thrombus causing gangrene of both extremities. Other conditions reported as giving rise to aseptic renal infarcts are trauma, peri-arteritis nodosa and infectious

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diseases. Rabinowitch reports one case with complete infarction of the kidney caused by direct invasion of the renal artery by a squamous cell carcinoma of the kidney.

Clinical and post-mortem studies in our cases indicate that there are no reliable criteria available which might serve to distinguish aseptic renal infarction from other common renal disorders for which renal infarcts are often mistaken. It is a well known fact that aseptic renal infarction frequently occurs without any symptomatic or physical expression of its existence. For that reason the condition is more commonly a post-mortem finding than a clinical manifestation, and is therefore more familiar to the pathologist than to the surgeon or clinician. In 64.7 per cent of the cases studied by Barney and Mintz, there was no history of pain or local tenderness. In the series of cases of endocarditis reported by Blumer, only one third of those with renal infarcts gave some clinical evidence of renal involvement.

The outstanding symptom, if present, is pain, the degree of which depends upon the extent of the embolic lesions. The character of the pain does not differ from that commonly associated with other renal disorders such as intra-renal or perirenal infection or calculi. The pain is usually in the lumbar region and may simulate an attack of renal colic as it did in Case 1 in our series. If the main renal artery or a major branch is occluded, severe abdominal pain with marked muscle rigidity may be present, as it occurred in Case 5. This may be so pronounced as to lead one to suspect a perforation of a viscus. In Cases 2 and 3 the pain was first so localized as to simulate an acute inflammation of the gall bladder or appendix. Local tenderness over the costovertebral angle has been consistently present. A striking feature in the five cases reported here was the presence of costovertebral tenderness appearing first on one side, then on the other. The presence of pain in the renal region in those patients with bacterial endocarditis is not always indicative of gross renal infarcts. The occurrence of embolic glomerular lesions so well described by Lohlein and Baehr as characteristic of streptococcus viridans endocarditis, may cause the same degree of pain and local tenderness as though gross infarcts were present. This is well illustrated in Cases 2 and 4. Constitutional symptoms, such as high temperature, nausea, vomiting and weakness, (all present in the five cases), were manifestations of the primary medical condition rather than of embolic lesions.

Urinary symptoms such as frequency and painful urination have been present in some of the cases reported by Libman, Blumer, Aschner and others. In the series reported by Barney and Mintz 9 per cent had urinary symptoms.

The urine usually shows the presence of albumin, red blood cells, white blood cells and casts, especially if the embolic manifestations are secondary to bacterial endocarditis. According to Baehr, most of the cases with streptococcus viridans endocarditis, will disclose red blood cells in the urine if carefully examined. Gross hematuria occurred in Case 4. In one third of the cases studied by Barney and Mintz, the urine was normal.

Diagnostic means other than clinical are unfortunately lacking for establishing the presence of renal infarcts in general. Routine urologic study is usually negative. Cystoscopy and radiographic study are generally of little value, but serve nevertheless in a negative manner by excluding other lesions which may be suspected. Cystoscopy was done in two of these cases and did not disclose evidence of renal pathology. Diminished renal function will be found only if extensive infarction is present, or when there is considerable glomerular damage.

Because there are lacking characteristic clinical and diagnostic features which would permit recognition, diagnostic errors are not only common but sometimes lead to unnecessary surgery, as one might infer from the first three cases. Bishop reports an

interesting case which was treated for a urologic condition for some time before it was discovered that bacterial endocarditis existed. Rathbun also reports a case operated upon for a primary renal disorder and at operation multiple renal infarcts of unknown origin were found. There are probably many other similar cases which are not reported.

Unless one considers this renal lesion when attempting to determine the pathologic basis of urinary complaints, it will probably be overlooked, especially when that systemic disorder known to give rise to renal embolic lesions remains unrecognized.

Subacute bacterial endocarditis is the most common source of renal infarcts. It is, therefore, of great advantage to the surgeon or urologist to be familiar with the cardinal features of this heart lesion so that when a renal infarct does occur, he will recognize the association of these two conditions and avoid the pitfalls in diagnosis. Careful co-operation between the surgeon and clinician is not only desirable but necessary, for occasionally a case of endocarditis is so obscured by embolic lesions that it remains undetermined until post-mortem study, or until an operation is performed.

Because of the persistent pain in the renal area and elevation in temperature, one often suspects a septic infarct or perinephric abscess, as in Cases 1, 2 and 3. A striking feature in the cases reported here was the presence of bilateral costo-vertebral tenderness.

When the surgical error is committed and the surgeon at operation discovers, instead of the suspected renal pathology, a renal infarct or "flea bitten" kidney, it is important that he appreciate the significance of such pathologic findings, in order to avoid the unnecessary removal of the kidney in the mistaken belief that this unfamiliar pathologic alteration justifies a radical procedure. Libman cites two such instances.

An aseptic renal infarct is not an operative lesion; operation is performed when it is mistaken for some other acute condition. Infarcts per se are of little significance if associated with a benign systemic disorder, giving rise to them. It is a common post-mortem experience to find small infarct scars of long standing, which most likely gave none or possibly slight and unrecognized clinical evidence of its occurrence. Renal function is usually unimpaired, for these infarcts are generally small and kidney destruction is slight. In one patient, post-mortem examination disclosed considerable atrophy of one kidney, apparently of long duration, which was attributed to occlusion of one of the major renal arterial vessels, the seat of severe sclerosis; this finding was accidental and was not responsible for the death of the patient.

The seriousness of this renal lesion depends entirely on the systemic condition responsible for its production. Infarcts occurring in the course of bacterial endocarditis are fatal because the latter condition is a grave one.

On the basis of our post-mortem accidental findings of renal infarcts or scars indicating that an infarct had occurred, there can be no doubt that this lesion occurs much more frequently than suspected. I sometimes wonder if the many patients, (especially past middle life, when cardiovascular changes begin to appear), who come to us with complaints suggesting some renal pathology such as stone or infection, and in whom thorough urologic study yields negative results except for a few abnormal elements in the urine, are not instances of small renal infarcts. Although this conception seems speculative, yet clinical and post-mortem studies seem to support such a view.

The following cases are briefly reported with their salient features.

Case 1. J. K., male, 60 years old, was admitted to the hospital because of pain in the left lumbar region which radiated to the groin. The pain first appeared two weeks before admission and was not very severe; some relief was obtained by the application of a hot water bag. Associated with this pain were chills and

fever. The patient appeared to be healthy and well nourished. Heart and lungs were negative. There was pronounced tenderness over the left costo-vertebral angle suggesting a left kidney lesion. Examination of the urine and blood failed to reveal any abnormality; the temperature was 101°F. On cystoscopic and Roentgen examination, no lesion was found anywhere in the urinary tract. His temperature continued between 100°–104°F. for about one week, when it became normal. After ten days he felt somewhat improved, so he released himself. After five days' stay at home, he returned to the hospital feeling much worse. He again had chills and fever and now had vomited several times. His general appearance was about the same; heart and lungs were still negative; the tenderness was quite pronounced over the left costo-vertebral space, and to a lesser degree on the right side. A few days later, crepitant râles were heard at the bases posteriorly but not enough to account for the septic clinical course. The urine now showed some white cells and occasional casts. The blood culture was negative; the temperature continued between 100°–103°F.

Because of the persistent and pronounced tenderness over the left kidney region, it was now considered very probable that there was a left perinephric abscess. Roentgen examination was of no assistance. This impression was somewhat supported by a rather vague history of the presence of a boil several weeks before. After two weeks of observation and in the absence of other findings to account for the clinical course and the persistence of local tenderness, it was deemed advisable to explore the left renal region. One month after admission, he was operated upon. There was no perinephric suppuration. The kidney itself, however, had several small infarcts which was sufficient evidence that we were probably dealing with subacute bacterial endocarditis. Five days after the operation, petechiae, which were previously searched for, now appeared on both lower eyelids and the roof of the mouth. Repeated blood cultures were sterile. He continued a septic course and on the twelfth day after the operation, he died in cardiac failure.

Post-mortem examination disclosed a bacterial (streptococcus viridans) endocarditis, multiple infarcts in both kidneys and microscopic evidence of embolic glomerulonephritis.

Case II. M. E., female, 13 years old, was admitted because of headache, fever and vomiting, which began two weeks before. During the past four days her temperature ranged between 100°–103°F. On physical examination nothing was found to account for the symptoms. The urine showed a faint trace of albumin and some white blood cells. Blood examination was negative. The impression was that she was recovering from influenza. Two days after admission a few râles were heard at the left base posteriorly and tenderness was found over the right costo-vertebral angle. The urine showed many more W. B. C. and albumin. In view of these findings and the temperature, the following possibilities were considered: influenza, pneumonia, tuberculosis, and a right renal or perinephric infection. Four days after admission this patient appeared acutely ill. There now developed an indefinite but very tender mass in the right upper quadrant which extended down towards the lower quadrant. Several petechiae were noted in the right lower lid and the hard palate. Apparently, no significance was attached to these findings. Tenderness in the right costo-vertebral angle became more pronounced, and to a lesser degree was present on the left side. The red cell count now ranged between 2,000,000 and 3,000,000 and white cells between 11,000 and 30,000; the hemoglobin dropped to 45 per cent. The following lesions were now considered as likely to be present: Acute cholecystitis, retrocecal periappendicular abscess, perinephric abscess and possibly a perforated gastric or duodenal ulcer. After a surgical consultation, it was felt that this patient was now too sick for any operative intervention and therefore supportive measures were continued. On the sixth day after admission a transfusion was given and this was followed by a laparotomy. No intraperitoneal lesion was found; the appendix and gall bladder were normal. The right kidney was palpated and found twice the normal size. The patient continued a septic course and was quite ill. There was exquisite tenderness over the right kidney and in spite of negative Roentgen findings of the urinary tract, exploration of the right renal region was deemed urgent three days after the laparotomy. There was no perinephric suppuration. The kidney was greatly enlarged and had a mottled appearance; several punctures failed to disclose evidence of

suppuration in the kidney proper. The following day the patient developed a diffuse rash. Blood cultures, which were repeatedly sterile, now showed a growth of 25 colonies of B. influenza per c.c. of blood. The urine now showed many pus cells, red cells and granular casts. The temperature ranged between 101°–105°F. Three days after the second operation, death occurred from a virulent sepsis and cardiac failure. Post-mortem examination revealed subacute bacterial endocarditis involving the mitral valve and lower surface of the aortic cusp. Crushings from the vegetations showed B. influenza. The spleen had two large infarcts. The kidneys had no gross infarcts but showed microscopic evidence of embolic lesions.

Case III. A. F., female, 47 years old, was admitted because of pain in the right upper quadrant. This pain which was present from time to time during the past eighteen months, radiated to the back and right shoulder and had no relation to meals. She was told that it was due to gall bladder disease. On examination, this patient appeared sick, but heart and lungs gave no evidence of disease. There was tenderness in the right upper quadrant and right costo-vertebral angle. The urine showed albumin++, pus clumps, a few red cells and granular casts. Blood count showed red cells 4,200,000, white cells 14,000, polymorphonuclears 92 per cent and lymphocytes 8 per cent. The following day the tenderness in the right upper quadrant and right costo-vertebral angle became very marked; there was a severe chill, followed by a temperature of 105°F. A blood culture was sterile and a Widal test was negative. The impression was that there was an acute cholecystitis or possibly a right kidney infection with a perinephritic abscess. About six days after admission a blowing systolic murmur was heard over the apex and costo-vertebral tenderness was now present on the left side. After a medical consultation, it was thought there was some myocardial involvement; the lungs were apparently normal. Urologic study failed to establish any definite lesion. Roentgen examination of the lungs, gall bladder, and spine also failed to reveal any lesion. The possibility of a pylephlebitis secondary to a high retrocecal acute appendicitis was also considered. About eighteen days after admission, abdominal exploration, which seemed to be justifiable because of the persistent abdominal signs, disclosed a normal appendix and gall bladder. The right kidney felt enlarged. The patient continued a clinical course suggesting a sepsis of unknown origin. The red cell count now was diminished to two million, white cells elevated to 21,000; repeated blood cultures were sterile; urine findings were the same as on previous examinations. Transfusions were given, but the patient died six weeks after admission from cardiac failure.

Post-mortem examination disclosed bacterial endocarditis. The crushings of the valves showed biscuit shaped organisms. The kidneys and spleen had infarcts while there was microscopic evidence of glomerulonephritis.

Case IV. J. S., male, 27 years old, became ill six weeks before with a sore throat and temperature 103°F., followed a few days later by painful swollen joints. One week before admission, he passed smoky urine. On examination this patient did not appear acutely ill; the lungs were normal and the heart showed no evidence of any organic lesion. Bilateral costo-vertebral tenderness was present. Abdominal palpation gave no evidence of any intra-abdominal condition. The extremities showed areas of muscle tenderness and some pain on motion of the larger joints. The urine showed albumin, red cells, white cells and granular casts. Blood examination revealed red cells, 3,600,000 white cells 13,600, polymorphonuclears 84 per cent, lymphocytes 16 per cent, and hemoglobin 70 per cent. The temperature was 101°F., the blood pressure 160 systolic and 110 diastolic.

The impression was that he began with a streptococcus sore throat which was complicated by glomerulonephritis and infectious arthritis. For the following twelve days his condition remained the same; the temperature ranged between 100°F. and 102°F. He then suddenly went into collapse; his pulse was very rapid and weak; he appeared very pale and complained of severe abdominal pain. The urine was grossly bloody. His condition was thought to be due to myocardial failure or impending uremia; the blood pressure fell to 70 systolic and 40 diastolic. The following day the pain became more intense and a mass developed in the right flank which was very tender. It was now seriously considered that there might be an embolic lesion in the right kidney or mesenteric vessels secondary to a subacute endocarditis. The mass was accounted for by blood extravasation. The mass continued

to increase in size, became more irregular and tender and extended from above the umbilicus to the pelvis; some rigidity was present directly over the mass. Eight days after the onset of this abdominal complication, the abdomen was explored and it was found that this mass was an extensive retroperitoneal hematoma surrounding the kidney. It was evacuated and drained.

The patient's condition did not permit any extensive search for the source of this bleeding. Periateritis nodosa of the renal artery was strongly considered as an etiologic factor. The patient appeared more comfortable after the operation. By this time a loud blowing systolic murmur was heard at the apex transmitted to the axilla. The red cell count and hemoglobin had dropped considerably. The possibility that this was a functional murmur was considered. Transfusions were given. Sixteen days after the operation, during which time the wound was draining a sero-sanguinous discharge, there occurred a severe hemorrhage from the wound which was controlled by packing. During the next six weeks, the patient continued a septic course and had several more hemorrhages from the wound. The hemoglobin had dropped to 10 per cent, red cells to 1,300,000; the platelet count was 350,000. Repeated transfusions were given. The patient's condition was too critical to permit adequate exploration of the renal area in an attempt to find the bleeding point. Repeated blood cultures were sterile. The subsequent clinical course was that of a sepsis of unknown origin, subacute endocarditis with embolic manifestations being strongly considered. About fourteen weeks after admission, he died of exsanguination.

On post-mortem examination the following conditions were found: subacute endocarditis on an old rheumatic mitral valve, embolus of the mesenteric artery with an aneurysm which ruptured, forming a large hematoma in the mesentery, perirenal and subhepatic areas. The kidneys showed no gross embolic lesions but microscopically showed extensive glomerular damage.

Case v. A. I., male, 58, was admitted complaining of pain on the left side of the neck and precordium, radiating down the left arm for the past week. He had rheumatism at the age of 14. On examination he appeared emaciated; there was tenderness over the cervical vertibrae. The lungs showed no evidence of disease; there was a systolic murmur at the apex transmitted to the left axilla; abdominal examination was negative. The urine showed a few white blood cells and a trace of albumin; the blood findings were negative. The blood pressure was 155 systolic and 100 diastolic. The clinical impression was that of an arteriosclerotic heart, rheumatic endocarditis and cervical arthritis. The latter was confirmed by *x*-ray examination. Electrocardiographic study disclosed a sinus rhythm. He continued for five weeks with a low grade temperature and without further physical evidence of any organic lesion. Subacute bacterial endocarditis was also considered. G.C. complement fixation and the Wasserman were negative. A nonhemolytic streptococcus was found in the fluid expressed from his prostate. He released himself after five weeks without feeling improved.

One month later, he returned with identical complaints as before; marked weakness was now present. His physical status had not changed. Laboratory findings were now as follows: urine showed a heavier trace of albumin with some red and white cells and casts, and there was now a moderate anemia. Several blood cultures in the next few weeks were sterile. About two weeks after this admission he was suddenly seized with severe agonizing pain in the left side of the abdomen and lumbar region. His temperature which ranged between 99° and 101°F. suddenly rose to 104°F. There was marked rigidity of the left half of the abdomen with pronounced tenderness most marked in the left costo-vertebral space. In view of the suspicion that this patient might have subacute endocarditis, the surgical opinion was ventured that there might be an embolic lesion of the left kidney with a resultant infarct. A calculous obstruction and pyelonephritis and septic infarct were also considered. This patient appeared very ill. There was no indication for surgical intervention. After one week there was gradual improvement; the local tenderness and rigidity gradually subsided. There was slight tenderness in the right costo-vertebral angle. His condition now permitted *x*-ray study of the urinary tract. This failed to disclose any calculus, perinephric abscess, or carbuncle. His condition would not permit cystoscopic study. He continued a septic course, the temperature ranging between 99° and 104°F. Four more

blood cultures taken a few weeks before death showed many colonies of staphylococcus albus. He continued downhill and died in left ventricular failure.

On post-mortem examination the following was found: subacute staphylococcus endocarditis of the mitral, tricuspid and pulmonic valves. The right kidney had a "flea bitten" appearance and an anemic infarct; it weighed 160 grams. The left kidney weighed 60 grams and was the seat of subtotal infarction; there were two renal arteries, one being completely thrombosed. Some attempt at canalization was noted. There was a thrombus in the accompanying vein. Both kidneys showed evidence of embolic glomerulonephritis.

## COMMENT

From our clinical experience, we would conclude that a renal infarct is a rare lesion, but according to our post-mortem records, it occurs more frequently than we are able to recognize clinically. The reason for not recognizing it lies in the fact that the symptoms which are not distinctive, are present only in a small number of cases and are usually interpreted to be due to some other renal or surgical disorder. Unless one is aware that a systemic disorder exists, which commonly gives rise to renal infarcts, the latter will usually be overlooked. This is illustrated by the cases reported here. The recognition of this renal lesion is highly desirable in order to avoid not only unnecessary surgery, but needless instrumental diagnostic procedures.

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# TRANSURETHRAL PROSTATIC RESECTION

## A REPORT OF 101 OPERATIONS ON 86 CASES

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THE importance of various types of transurethral procedures has gained considerably in the last ten years. Practically all small and medium sized benign papillomata of the bladder are treated by transurethral methods. Pulling off these sea-weedy growths and fulgurating their pedicles has become a popular procedure. The McCarthy resectoscope has been used with success on such neoplasms as occur about the bladder neck and trigone. Transurethral implantations of radium or radium emanation have been used extensively. The passage of ureteral calculi, that have not become impacted, and measuring less than 1 cm. in diameter, is greatly facilitated by cystoscopic manipulation. Bladder calculi measuring 3 cm. in diameter or less are usually crushed by the ithotrite and the fragments washed out.

These procedures have become common to all those practicing urology and as the operator's skill has improved he has increased his sphere of activities. Considering the growth and development of these previously mentioned transurethral procedures it seems only natural that progress should have been made in the treatment of bladder neck obstruction.

All but four of this series were done with the Braasch-Bumpus punch instrument. The other four were done with the McCarthy resectoscope. I do not wish to enter into a controversy as to the relative merits of these two instruments. In the hands of the expert the mortality and the end-results appear to be about equal. I do believe however, that for the beginner the punch instrument is the safer one to use. After one has familiarized himself with the landmarks, the principal ones being the verumontanum and the ureteral orifices, the actual resection is safer with a punch instrument than with a cutting current. With the punch instrument there is no destruction beyond the path of the cutting knife. The cold knife eliminates such technical factors as the strength of the current, the length of the cables transmitting this current from the high frequency machine, and the speed with which the cutting loop is moved. These factors cause considerable difficulty for the beginner.

A great deal of the difficulty that has been encountered by the average person attempting to do this operation has been the result of the way this whole situation was originally presented by those who did the pioneering. The procedure was recommended as one that carried a very low mortality and morbidity. An insufficient emphasis was placed upon the groundwork necessary to obtain these desirable results. These encouraging results were sufficient to stimulate an almost universal desire to do these operations.

Historically, the development of the Braasch-Bumpus punch has been a very simple and logical evolution. (Figs. 1–5.) Hugh Young introduced the knife punch in 1910. There was no attempt at visualizing the tissue to be removed. The operation was done blindly and entirely by the sense of touch. Braasch recognized the essential similarity between his direct cystoscope and the Young punch. He modified it by having a plain glass window fitted to the end of the Young punch. Anyone accustomed to the direct vision cystoscope could then see what he was doing. Further improvements were made, such as adding the fulgurating

electrodes, but extensive resection of any considerable amount of tissue was not possible with this instrument until 1932, when Tyvand designed the multiple-point electrode which permitted the local dehydration of engaged tissue before it was cut with the circular knife.

Thompson has made further changes in this instrument by incorporating the fulgurating electrode and the knife in the sheath of the cystoscope. I have one of these instruments, but so far my efforts with it have not been as successful as with the old instrument.

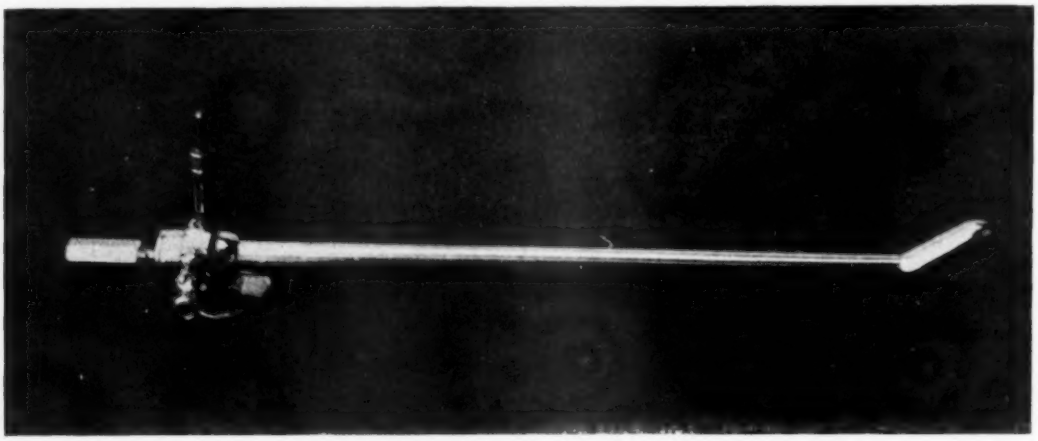

Fig. 1. Braasch-Bumpus resectoscope.

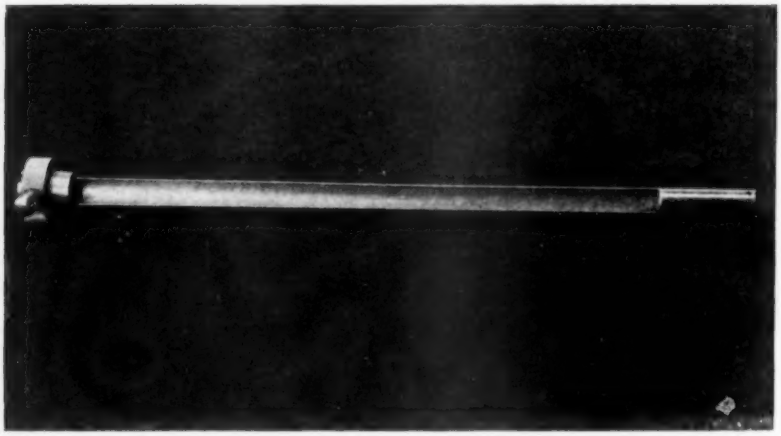

Fig. 2. Hollow obturator which is used to convert resectoscope into cystoscope.

### PREPARATION FOR TRANSURETHRAL PROSTATIC RESECTION

All cases are examined by an internist for evidences of cardio-vascular or pulmonary disease. Blood chemistry is done and plain *x*-ray of the urinary tract. Plain *x*-ray is particularly important to ascertain whether or not bladder calculi are present.

Cases that present themselves with complete urinary retention, or with residual urine of more than 2 or 3 ounces, should be prepared in the same manner as for any other type of prostatic surgery. Indwelling catheter is kept in for several days, depending on whether or not there is urea retention. The patient must be up and about and be able to walk up and down stairs without cardiac embarrassment.

Cystograms are frequently helpful. Recently we have been using the technique described by Alcock. Considerable information may be gained from these.

Cystoscopic examinations should be done at first when beginning transurethrals but later on I believe they should be

avoided whenever possible in pre-operative study. Alcock found his mortality increased in the group of cases cystoscoped.

patients were confined to the hospital longer with the inflamed epididymis than they were with the entire operation.

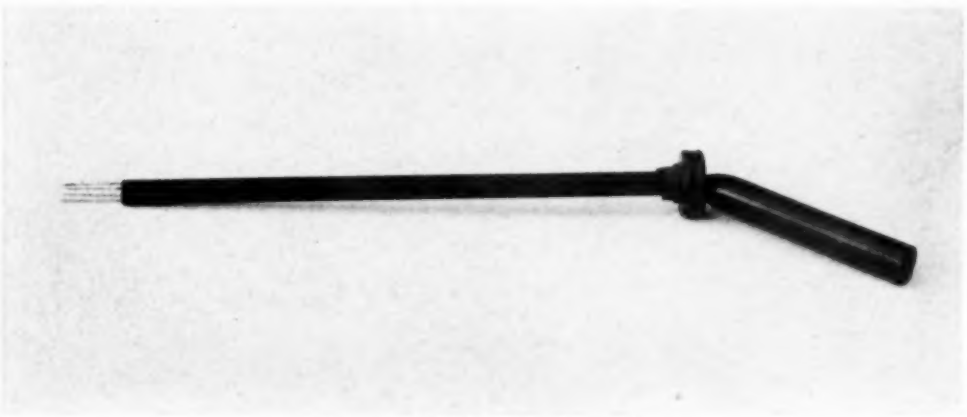

Fig. 3. Multiple point electrode.

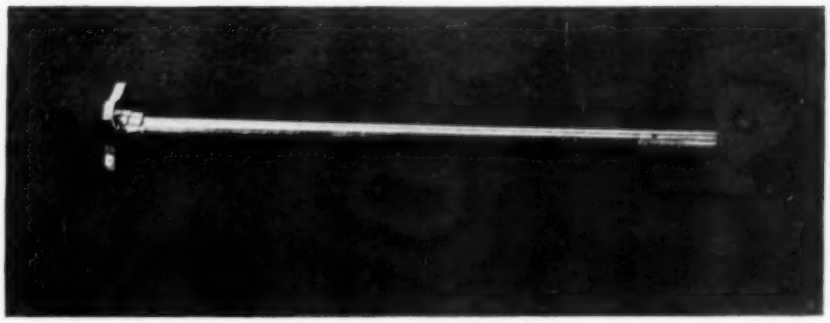

Fig. 4. Tubular knife.

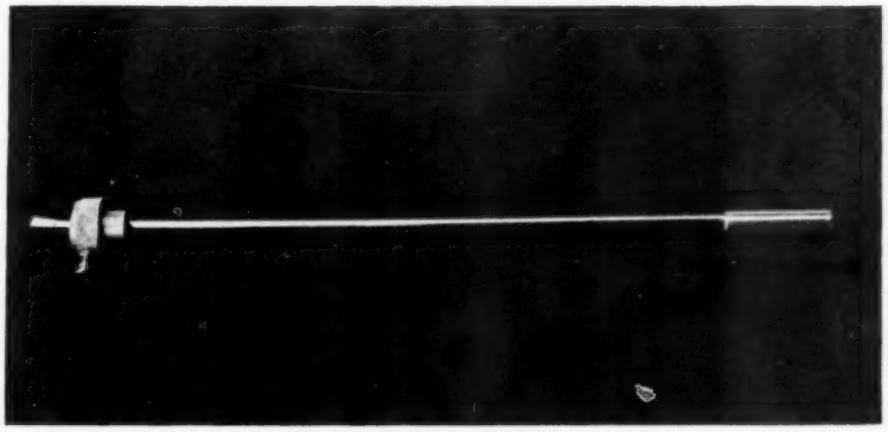

Fig. 5. Carrier for Bugbee fulgurating electrode.

Vasectomies were done routinely in this series in the last eighty cases. I believe it should be carried out in all cases over 60 years of age. Following the first few operations in this series there were two cases of epididymitis so severe that the

Rigid asepsis should be maintained as closely as possible in the pre-operative care of these patients. It is true that any case wearing an indwelling catheter for several days will usually present a turbid urine. If strict asepsis has been main-

tained, this turbidity will be produced by the patient's own organisms, and ordinarily very little ill effect is experienced from these. The principal object of our aseptic technique is to avoid the introduction of foreign strains of bacteria.

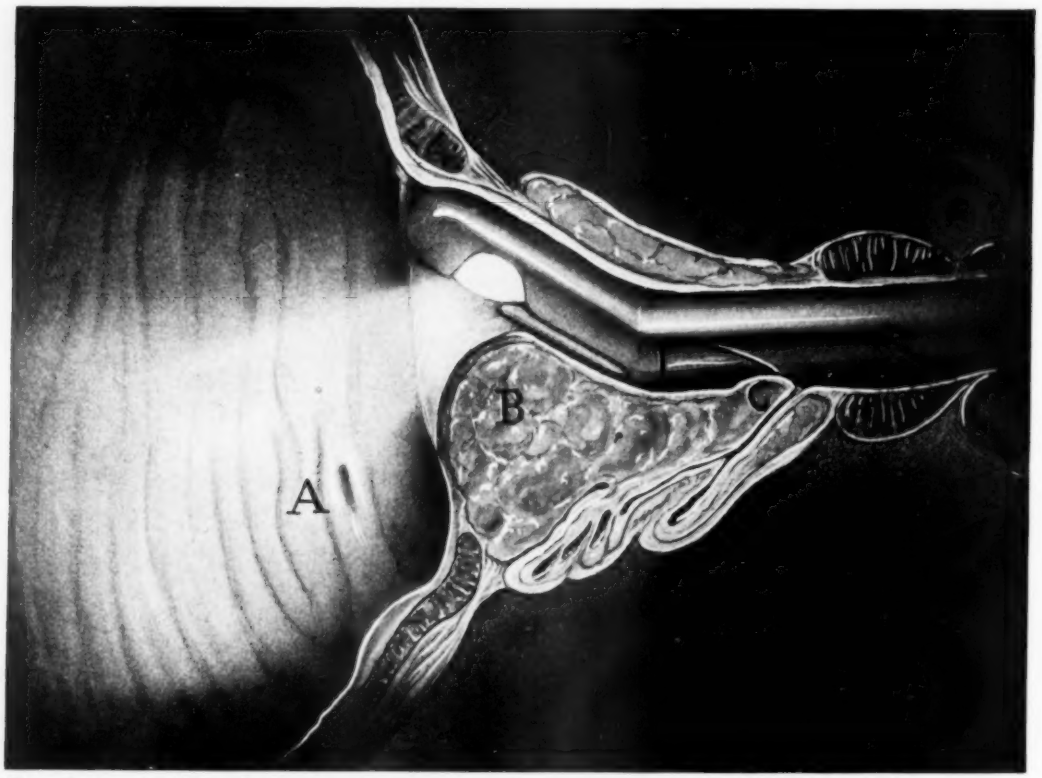


FIG. 6. Anatomical relationship. Resectoscope in the posterior urethra. Important anatomical landmarks designated by: (A) ureteral meatus; (B) obstructing median lobe of the prostate gland; (C) verumontanum.

### SELECTION OF CASES

This is one of the most important parts of the entire procedure.

In the first twenty cases, I attempted glands that I would reject without hesitation at the present time. One should begin with the simplest type of bladder neck obstruction requiring only a minimum amount of tissue to be removed until sufficient skill and experience have been obtained. Too much emphasis cannot be placed upon the routine examination of the posterior urethra in the male, to thoroughly fix not only the landmarks, but the appearance of the entire post-urethra and the external sphincter.

Residual urine is not the only criterion in the selection of cases for operation. We have all seen enormous prostate glands that have only a few cubic centimeters of residual urine or glands with a small amount of residual urine and distressing symptoms. Symptoms of dysuria, frequency and nocturia may be as important an indication as any other single finding.

At the present time I am resecting all obstructive types of malignant prostates. There are several reasons for this. Frequently the obstructing tissue may be removed with little difficulty, for it is avascular, cutting like cheese; secondly, when a channel is made in these cases it remains open because the surrounding mass of tissue is so rigid that it will not fall in. Resection of malignant glands is to be preferred to cystostomy; whether or not the instrumentation stimulates metastasis I am not in a position to say, but

the relief of obstruction in this hopeless condition is an important factor.

In this series, resection has been done on all types of benign obstructions, including adenomata of small and medium-sized glands. This group constitutes about 75 per cent of benign obstructive lesions encountered by the writer. The only female with bladder neck obstruction, occurring in this series, was a highly nervous spinster with an enormously hypertrophied internal sphincter. The imbalance between the neuro-muscular apparatus had developed to such an extent that she had almost complete retention of urine for six days before operation. We realized we were treating effect rather than cause, but the distress was so great that it was decided to resect the internal sphincter. One large bite was removed from the mid-line and this has been followed by almost two years of relief.

Small stones occurring in the presence of small bladder neck obstruction are crushed with a lithotrite and the obstructing bladder neck is resected at a subsequent sitting. It is important to remove the calculus first and not attempt to do the resection in the presence of a bladder calculus. The calculus will interfere with the movement of the resectoscope. It will also interfere with the catheter drainage following resection and, even more important, it will drop into the funnel-shaped excavation at the bladder neck and cause complete retention of urine after the catheter is withdrawn. Large bladder stones, or those occurring with large prostates, should be removed by the suprapubic route.

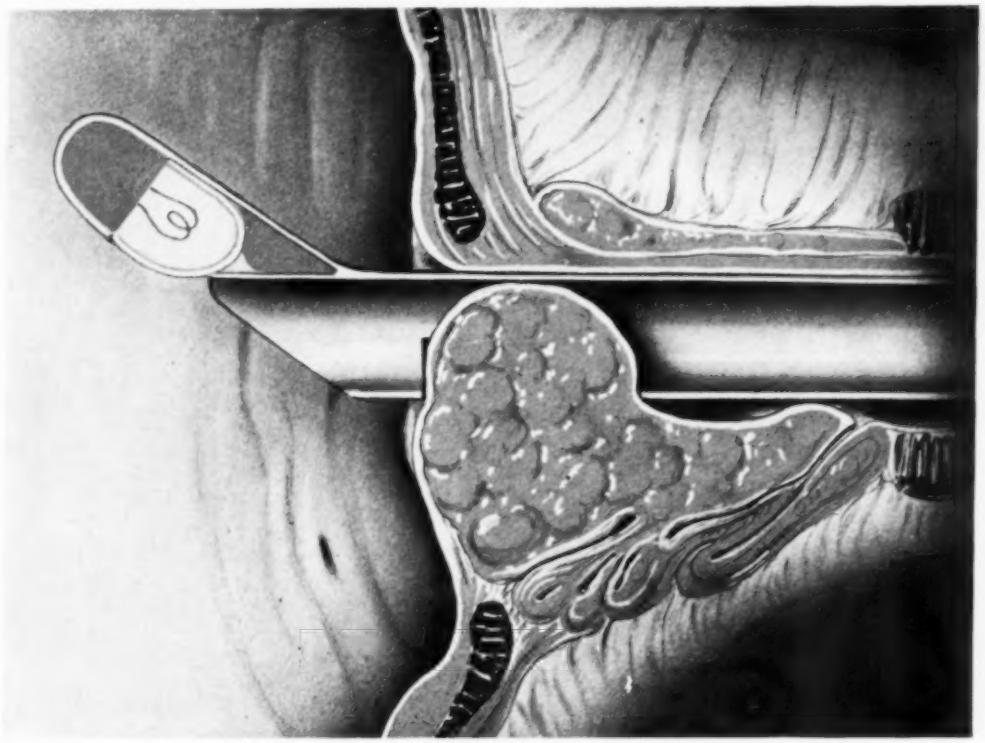

Fig. 7. Obstructing tissue engaged in fenestrum of resectoscope.

Three cases in this series had prostatic calculi. It is interesting to note how easy it is to remove these stones after the surface of the prostate gland has been resected. Results in these cases are extremely good.

Diverticula of the bladder respond very well after the bladder neck obstruction has been relieved. Three very large diverticula occurred in this series, one having a capacity of 22 ounces and the others a capacity of 16 ounces and 8 ounces respectively. All of these cases emptied their bladders

satisfactorily and had no residual urine after eight weeks of observation. It takes about this length of time for the diverticula to shrink down and regain their muscular tone following the relief of obstruction.

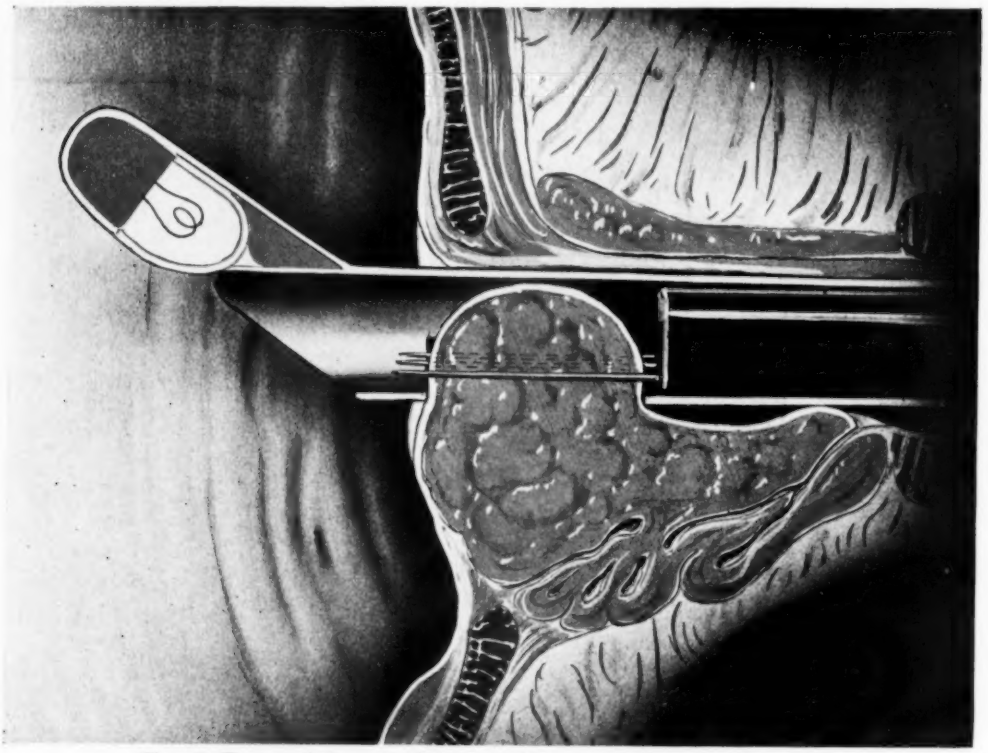

Fig. 8. Engaged tissue is dehydrated by multiple point electrode.

### POST-OPERATIVE CARE

An indwelling catheter is taped into the urethra for seventy-two hours post-operatively. For the first two hours, constant attention is required to be sure that blood clots are not forming in the bladder. We are working on an automatic irrigating device which we hope will replace the manual irrigation of this catheter. The catheter is removed at the end of seventy-two hours. If the patient is unable to void, the catheter is replaced for another twenty-four hours. A test for residual urine and bladder lavage is made once or twice a day following this until the patient leaves. The urine usually remains cloudy from six to eight weeks post-operatively.

Considerable edema may occur after operation and this should disappear, in most cases, in from three to four days. If residual urine of more than one ounce persists after four days, it indicates the presence of obstructing tissue that has been missed at operation.

### COMPLICATIONS

Post-operative reaction is the most common complication. It was severe in ten cases, where the temperature rose to over 102°. It is generally in direct proportion to the weight of tissue removed, and the length or duration of operation. The remaining ninety-one operations had relatively slight reactions with temperatures of less than 102°, and forty-four of these had one degree or less. None of these cases had any prolonged course of chills and fever such as I have found described by other writers. The previously mentioned febrile reactions, without exception, ended in forty-eight hours.

One severe reaction occurred in case J. O., 73 years of age. He was admitted to the hospital with chills and fever and 6 ounces of residual urine. His gland was of

medium size by rectum and benign. Indwelling catheter for continuous drainage was instituted. Following this his temperature remained nearly normal for four days. At this time a transfusion of 350 cc. of citrated blood was given because of his poor general condition and secondary anemia. A slight reaction followed. However, on the eighth day after admission he was in such condition that a transurethral operation was performed and 9½ grams of benign tissue were removed. Very little reaction followed immediately after the operation. His temperature remained under 99.8 until the third day when it rose to 102 degrees with a chill. There was swelling and redness of the right elbow joint. Several days later there was also pain in the left shoulder and shortly after this the right knee became swollen and tender. The right elbow and left shoulder cleared up fairly rapidly, but the pain and stiffness in the right knee persisted. He was discharged on the fourteenth post-operative day.

This trouble was undoubtedly caused by a shower of bacteria in the blood stream. Blood cultures were, however, negative. The patient has been followed for almost a year. He has almost completely regained the use of his right knee and has no residual urine.

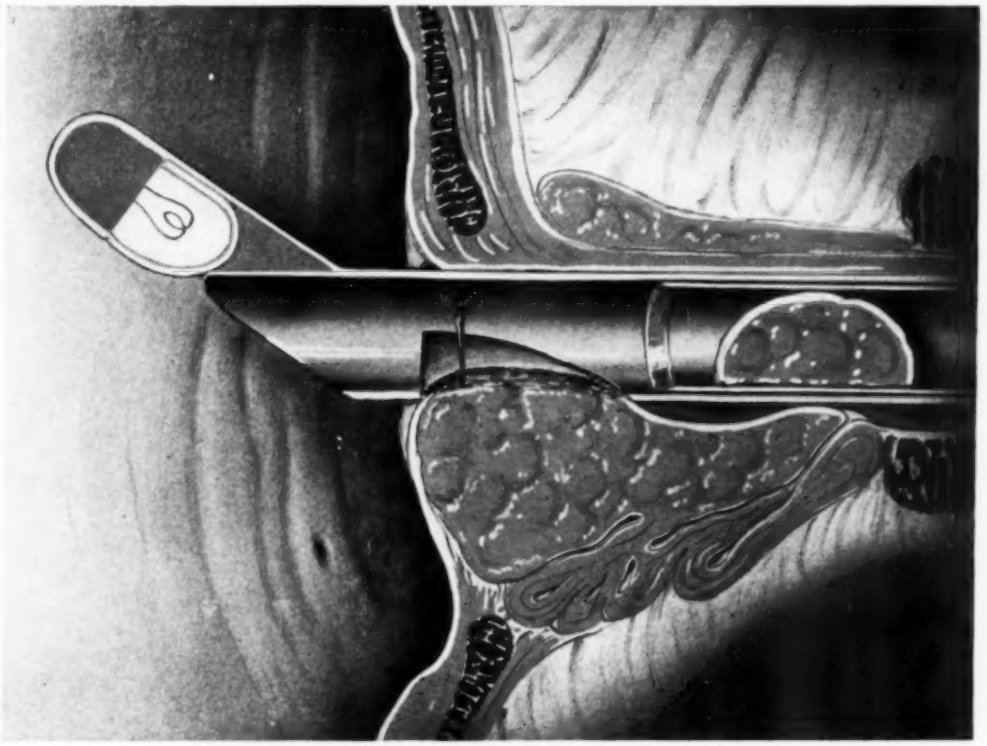

Fig. 9. Obstructing tissue resected by a tubular knife.

Hemorrhage may be extremely annoying and trained personnel in the hospital is important. Bleeding at operation should be closely watched. It is possible to work in much bloodier medium with the direct vision punch instrument than with the McCarthy instrument. For this reason, those using the punch are likely to become careless about controlling bleeders. Severe bleeding was encountered twice during operation in this series. One case was successfully controlled by electrocoagulation; in the second case the spinal anesthesia was beginning to wear off and an emergency suprapubic cystostomy had to be done. This is the only cystostomy that had to be done for hemorrhage. Both of these cases made complete recoveries.

Post-operative bleeding may be early or late. The early bleeding occurs usually in the first twenty-four hours. Several, about 10 per cent, bled fairly severely after being

sent back to bed. Alcock advises taking these patients back to the operating room and giving them second spinal anesthesia

Urethral stricture has been occasionally reported. Three cases occurred post-operatively in this series. All of these occurred

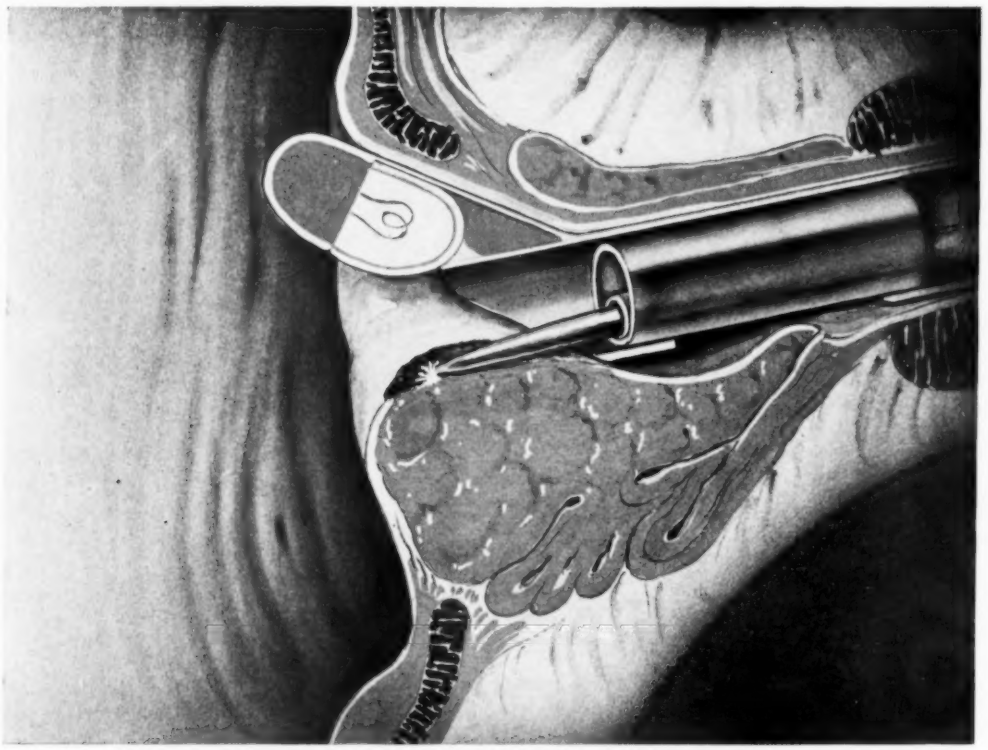

FIG. 10. Electro-coagulation of individual spurters.

and fulgurating the bleeders. In most cases this is not necessary. The most important factor in hemorrhage into the bladder is to prevent it from filling with clots. The indwelling catheter is closely watched and if bleeding becomes severe, the catheter is lavaged more frequently. Thompson has devised a very practical clot evacuator to use on these cases. After the clots are evacuated, a hemostatic bag may be introduced. The bag must be so constructed that irrigation may be carried out while it is in use. Six cases were transfused. Cystostomy should be avoided if possible. All of the equipment mentioned must be at the operator's disposal at all times so that any emergency may be properly dealt with.

Delayed bleeding occurs in over 50 per cent of the cases where more than 5 grams of tissue are removed. This occurs usually in the third week. In this series I have had no cases of delayed bleeding severe enough to require any special treatment.

in the first fifty-nine cases, none having occurred in my last forty-two. They may be largely prevented by filling the urethra with lubricating jelly through a piston syringe.

Dribbling may occur following resection and it is undoubtedly due to instrumental trauma of the external sphincter. Approximately 10 per cent of these cases had dribbling that lasted on the average of ten to fourteen days. One case persisted for five weeks, and this occurred in a patient who had had a complete hemiplegia. The dribbling in all cases cleared up and there has been no permanent incontinence in this series.

## MORTALITY

A total of 101 operations was done on eighty-six patients. Mortality in these cases should be discussed in reference to two groups, because there is such a great difference between the mortality occurring in the malignant group and that in the

benign group. Thirteen operations were done on the malignant group with three deaths, and eighty-eight operations were done in the benign group with only three deaths; a total of six fatalities in 101 operations.

Multiple short sittings or operations are to be preferred to single long-drawn out procedures. At least two of the previously mentioned deaths could have been prevented. Fortunately, transurethral resection is one operation that may be discontinued at any moment. All operations should be strictly limited to one hour. Recently I have reduced this time to fifty minutes. The mortality is directly proportionate to the time spent and the amount of tissue removed.

One of the fatalities in the malignant group resulted from hemolytic streptococcus blood stream infection, as evidenced by positive blood cultures.

I have had only one fatality in the last forty-seven operations and I believe that the mortality record for the next one hundred cases will be less than half of that appearing in this group.

It would appear that I have presented all of the unfavorable and disagreeable things that have happened and that the operation had few desirable features. However, this is decidedly not the case. Any large series of prostate cases treated in any other manner will show an imposing group of complications. It is unquestionably true that the vast majority of the cases are out of the hospital in approximately one third of the time required for other types of prostatic operation. Eighty-four per cent of this series was hospitalized for an average period of only ten days following this operation. As has been previously stated, a fair percentage of this series was done in more than one stage and a varying length of time has been permitted between these stages. Ordinarily seven to ten days is the usual length of time. However, three cases were sent home to improve their physical condition before further resection was contemplated.

As one's technique improves the complications of hemorrhage and other annoying sequelae become progressively less. The amount of tissue removed is not always of the greatest importance. Complete obstruction may be caused by three grams of tissue properly situated as well as by an enormous gland. However, it will be found that, as one's skill improves, larger and larger amounts of tissue may be removed. The largest amount removed in this group at any single sitting was 23 grams and the largest amount from any gland 43½ grams at two sittings. Thirty-four of these cases, or approximately 40 per cent, had complete retention of urine. The remaining sixty-seven cases ran from one to ten ounces.

## CONCLUSIONS

It may be stated that transurethral resection is applicable to a large group of obstructive lesions. Its mortality is low, 3.3 per cent in the benign group of this entire series, and approximately 2 per cent for the last fifty cases. The period of hospitalization is short and the results are good.

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# EUCUPIN (ISOAMYLHYDROCUPREINE) AS A LOCAL ANESTHETIC IN PROCTOLOGIC SURGERY AND IN THE TREATMENT OF PRURITUS ANI

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IT is a curious paradox that pain is the predominant factor bringing a patient to his physician, but that it is also the element that frequently prevents him from seeking proper relief from his condition. This is not surprising, however, in view of the fact that practically all surgical procedures are associated with a certain degree of pain, and therefore require considerable fortitude on the part of the patient. This fear of pain, not only during operation, but for hours and days afterwards, causes a patient to postpone medical attention until his condition has progressed to a point where it can no longer be tolerated, and thus a minor ailment has often become a serious and extensive involvement. It is quite obvious, therefore, that any measure which can alleviate pain or aid in the maintenance of comfort is one of the great benefactions of mankind.

Approximately 95 per cent of all rectal conditions requiring the services of a proctologist occur in the anal canal, and consequently may be considered as minor ailments. However, the anesthetics frequently employed in anal surgery constitute in themselves serious sources of difficulty. Ether, though comparatively safe, leaves the patient feeling miserable and often necessitates the use of sedatives or hypnotics to control the post-operative discomfort. Spinal anesthesia, in our opinion, is also a serious procedure, and despite its increasing usage, is attended with danger. There have been many tragic deaths reported as a direct result of spinal anesthesia, in addition to the incidence of paralytic symptoms and frequent intractable headaches.

The trend of modern surgery is to localize the anesthesia in the region of the operative field, but although rapid strides have been made it must be admitted that the ideal local anesthetic has not yet been attained. In 1902 Braun[1] enumerated certain classical requirements for a local anesthetic, which will bear repetition. They are:

1. Low toxicity.
2. Solubility in water.
3. Sterility by heat without deterioration.
4. Compatibility with epinephrine.
5. Freedom from local tissue reactions.

At this time he also showed that the duration of local anesthesia, a matter of great importance, could be considerably prolonged by the addition of epinephrine to the anesthetic solution. Rectal surgery, because of the manipulation and surgical trauma about highly sensitive and constantly contracting sphincters, has need of an anesthetic which not only will be sufficient at the time of operation, but will also safely prolong the effect and thus maintain post-operative comfort. The latter is essential, since it is the fear and dread of post-operative pain that keep patients from seeking early advice and treatment for their rectal conditions. That this problem is appreciated by all surgeons, is evidenced by the large number of anesthetic compounds which are introduced with the claim of prolonged anesthesia.

Cocaine, the first local anesthetic, although vasoconstrictive itself, is not practical because of its fleeting action and

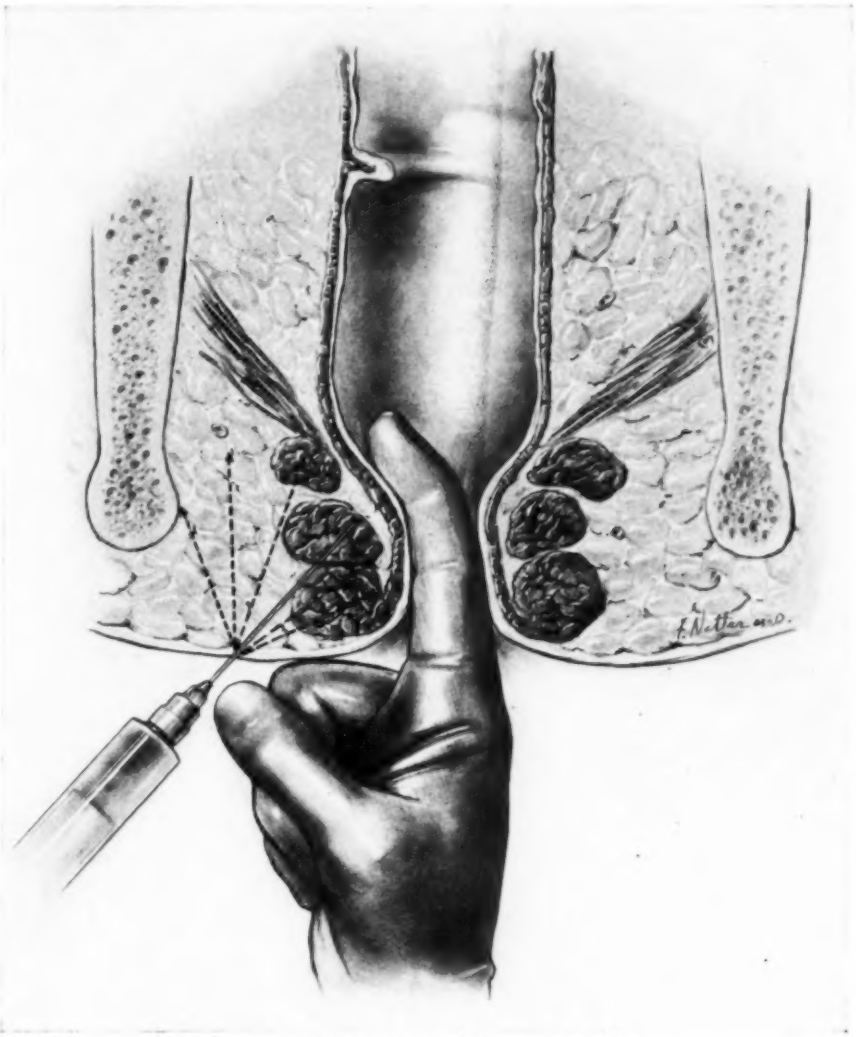

Fig. 1. Deep infiltration with aqueous solution.

toxicity. It has the added disadvantage of causing addiction if indiscriminately employed, and has given rise to severe systemic reactions in hypersensitive patients. Procaine, and many of the other cocaine substitutes, while fulfilling many of the requirements for a suitable anesthetic in some respects, also have the disadvantage that their action is of comparatively short duration.

Quinine salts have been studied by numerous investigators, who sought to obtain prolonged anesthesia without undesirable effects. It was pointed out that while a longer period of anesthesia is obtained with these solutions, there occur severe tissue reactions, such as induration, sloughing, and a slowly resolving deposit of intracellular fibrin. Kilbourne[9] believes better results are experienced with quinine and urethane solutions.

Several years ago Yeomans, Gorsch, and Mathesheimer[22] introduced oily solutions of anesthetics in proctology for the purpose of producing an unusually prolonged period of anesthesia. By this means it was found practical to employ high concentrations

of anesthetic agents in a slowly absorbed vehicle, such as almond oil, and to effect a retarded liberation of the anesthetic over other rectal conditions and as a surgical anesthetic in proctology.

It has been stressed by those who have

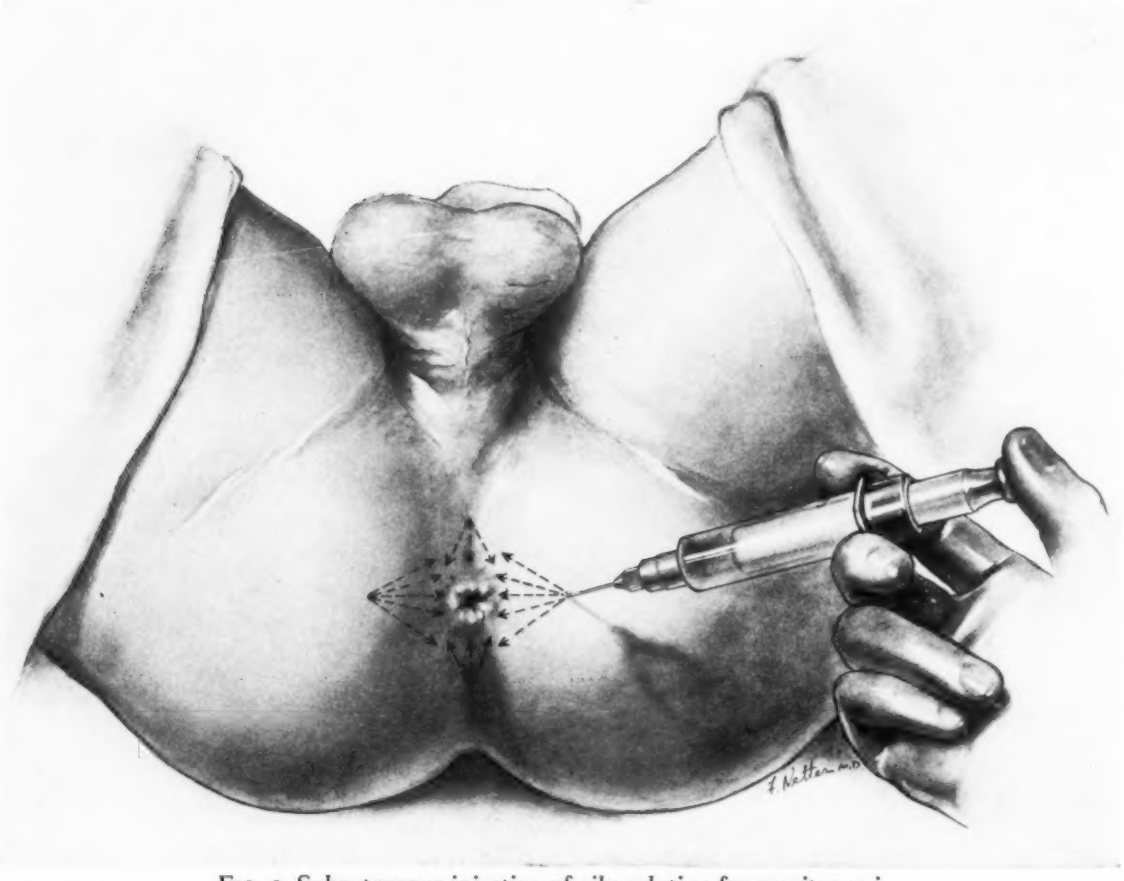

FIG. 2. Subcutaneous injection of oily solution for pruritus ani.

a period of several weeks. Subsequently several modified formulas were reported by Gabriel,[6] Gorsch,[7] Morgan,[10] and Burt.[2] One of us (M. M.), having had an opportunity to see and study the effects of these oily anesthetics as used by Gabriel of London and Bensaude of Paris, became impressed with the results obtained and the possible applications of these solutions to proctologic surgery. This type of anesthesia was originally introduced for the treatment of pruritus ani and its value in this condition was subsequently stressed by Gorsch,[7] Simmons,[17] Steinberg,[19] and others. More recently its use has been advocated by Gorsch,[7] Frankfeldt,[5] Hayes[8] and Wheeler[21] for the treatment of many

employed oil anesthetics that tissue reactions, as evidenced by induration and sloughing, sometimes occur. This is thought to be due to the occurrence of pooling of the solution instead of its even distribution in the perianal tissues. Whether the sloughing is due to faulty technique, too highly concentrated solutions, or to one or more of the ingredients we cannot be certain. The fact remains that induration and sloughing may occur even at the hands of careful and experienced men. These facts make the indiscriminate use of the various oil anesthetics in rectal operations inadvisable, since untoward results are possible, especially when these drugs are employed by those not thoroughly familiar with this

type of anesthesia or with the anatomy of the perianal region.

There has been a long-felt need for a water-soluble anesthetic of low toxicity which gives good initial anesthesia without undesirable tissue reactions, and which, at the same time, exerts a more prolonged action than procaine or similar compounds. On the other hand, there seems to be little need for anesthesia of two to three weeks' duration in any surgical procedure about the anus, since the average proctologic patient, if properly treated, has very little pain after the fourth or fifth day.

It was, therefore, decided to study and evaluate eucupin* as an anesthetic agent of prolonged action. This compound was studied by Morgenroth and his co-workers[11–15] and is of great interest because it was first introduced as a powerful germicidal agent for the disinfection of wounds and ulcers. For pyogenic organisms in a twenty-four hour culture its action is stated to be about 40 times that of phenol.[18] It was soon observed that its application was followed by anesthesia of unusually prolonged duration, a fact which prompted numerous investigators to study this particular property for clinical application.

Eucupin, or isoamylhydrocupreine, is not chemically related to cocaine, procaine, or the other benzoyl ester types of anesthetics, but is a quinoline derivative. It is more closely related to quinine, but differs greatly in its anesthetic and germicidal efficiencies. Morgenroth and Ginsberg[12] showed that the local anesthetic effect of eucupin was from twenty to twenty-five times as strong as that of cocaine, an observation which was later confirmed by Dixon and Premankur.[4] A matter of added importance is the investigation of Dawson and Garbade,[3] who pointed out that because of the long and branched side chain in the eucupin molecule, peculiar individual susceptibilities and natural idiosyncrasies to the drug are unlikely.

* The eucupin for this investigation has been supplied to us through the courtesy of Rare Chemicals, Inc.

De Takats[20] used eucupin 1:1000, in combination with procaine and tutocain, with success in 100 surgical operations, after preliminary wheal tests had showed that this concentration was devoid of any undesirable tissue effects. It was also pointed out that dermal wheals without eucupin became painful after the initial anesthesia. "On the other hand the anesthesia obtained with eucupin passes into an analgetic state; painless wheals and also a painless wound are observed even after the anesthesia is over." A 1:1000 solution of eucupin was found to be equivalent in anesthetic potency to about 2 per cent cocaine. No greater concentrations should be used for infiltration. The average duration of anesthesia which results from a combination of eucupin, tutocain, and epinephrine is about twenty-six hours.

Kilbourne[9] has recently reported his observations on the use of eucupin-procaine mixtures in proctology, and stresses the desirability of having the solutions as alkaline as is compatible with the solubility of eucupin. This corresponds to a *pH* of approximately 6. As a topical application in 0.75 per cent solution in distilled water eucupin gave excellent results after operations for anal fistula, pilonidal sinuses, and hemorrhoids. Patients usually experienced complete relief from pain for twelve hours or more as a result of this post-operative topical application.

In our initial studies on the anesthetic qualities of eucupin, a 1:1000 solution of the dihydrochloride alone was employed. With a small needle the skin and superficial portion of the external sphincter were infiltrated posteriorly, the course of injection following the sphincter on each side. A 20-gauge 2-inch needle was then substituted for the smaller one, and the left index finger, previously inserted into the anal canal, was used to direct the infiltration of the deeper perianal tissues and ischiorectal spaces. The larger needle was inserted posteriorly in the midline about one inch from the anal margin, and the solution injected as the needle was ad-

vanced. The same procedure was repeated from an anterior position, employing from 5 to 10 cc. of solution for each quadrant. The entire perianal region was then gently massaged, to ensure an even distribution of the solution.

In a series of cases in which eucupin 1:1000 in saline was used alone, the patient frequently experienced a burning sensation which persisted for several minutes. Usually from ten to twenty minutes were required to obtain the maximum anesthetic effect. The addition of 0.2 per cent procaine hydrochloride gave better initial anesthesia and served to reduce to a marked degree this undesirable feature. The slowness in onset of eucupin anesthesia is, we believe, evidence of its slow tissue diffusibility and, consequently, explains the unusually prolonged action. Another series of patients preferred general or spinal anesthesia, and while under the influence of these anesthetics local infiltration or pudendal block was accomplished with eucupin 0.1 per cent and procaine 0.2 per cent solution in amounts ranging from 20 to 40 c.c. This gave a very satisfactory anesthesia which lasted in the average case for about five days and occasionally eight days.

From this preliminary study it was decided to increase the procaine concentration to 1 per cent. With this solution we obtained immediate anesthesia, complete dilation of the sphincter, and post-operative anesthesia or hypoesthesia which persisted from three to seven days. The initial burning sensation, produced by eucupin alone, had been practically eliminated. *Tissue reaction was observed very closely, and in no instance was there the slightest evidence of induration or delayed healing. Despite the quinine relationship, no idiosyncrasies to eucupin were ever found.* Our experience with eucupin dihydrochloride 0.1 per cent, combined with procaine hydrochloride 1 per cent, has been so consistently satisfactory that we have adopted this solution as a routine local anesthetic in all operative cases except where the presence of infection makes the technique undesirable. Likewise, an apprehensive patient is sometimes encountered who fears the initial needle puncture as well as the operation itself. The pre-operative administration of sedatives will allay these fears to some extent, although we prefer the use of gas-oxygen anesthesia during the local anesthetizing process and in the first stages of the operative procedure. With this general anesthesia the sphincters are fully relaxed and the patients usually recover completely before leaving the operating room.

In the treatment of pruritus ani the problem is somewhat different from the general class of rectal conditions. Pruritus ani is a symptom and there is no specific etiology, pathology, and no therapeutic measure of specific curative value. In treating this condition it is advisable to obtain a maximum prolongation of local anesthesia, even though an occasional slough is produced. Two important things can be accomplished through this procedure: first, the patient is afforded relief from the distressing symptoms; and second, the perianal skin is given a much needed rest, thus permitting time for the restoration of normal physiologic processes within this area. For this purpose we have employed eucupin in oil, with the following formula: eucupin base 0.1 per cent, ethylaminobenzoate 3.0 per cent, benzyl alcohol 5.0 per cent, in expressed oil of almond. The addition of ethylaminobenzoate and benzyl alcohol is essential in affording a more rapid anesthesia and in reducing the viscosity of the oily solution.

The technique of injecting the oil differs from that generally used for aqueous solutions, and several methods of infiltration have been described in the literature. Complete circumanal injection of the oil is important, and the infiltration should be extended slightly beyond the border of the pruritic area. Injections are started at four points; anterior, posterior, and two lateral, as illustrated by the accompanying diagram. The skin at each site of injection is

preliminarily anesthetized by means of a procaine wheal before the insertion of the larger, oil-bearing needle. The oil is warmed to about body temperature and drawn into a 10 c.c. syringe. In our experience the B-D Luer-Lok type syringe with 20-gauge 2-inch needle has proven quite satisfactory for this purpose. Injection is made well beneath the skin in a fan-wise manner, and it is advisable to distribute the anesthetic slowly and evenly as the needle is being withdrawn from the position of deep penetration. From 3 to 5 c.c. in each quadrant or a total of 15 to 20 c.c. of solution for the entire perianal area is adequate; more than this amount conduces to tissue reactions. After completion of the injections the parts should be massaged very thoroughly to prevent pooling and to ensure an even distribution of the anesthetic.

Induration and sloughing rarely occur with this formula, but it must be borne in mind that we are treating pruritus ani, a very distressing condition, and if a measure of relief can be afforded it is well worth the risk of producing a slough. After the pruritic area has been anesthetized, surgery can be used to remove external skin tags, chronic fissures, hypertrophic rugae; even the superficial external sphincter may be injected to relax anal spasm. Furthermore, the pruritic skin can be safely denuded of its excessive cortical layer by the use of applications, for five consecutive days, of 3 per cent silver nitrate in spirits of nitrous ether. This combination therapy has given uniformly good results. The skin becomes dry, soft, and normal in appearance; the itching entirely subsides in many cases and is markedly relieved in others. Immediately following the injection of the anesthetic agent the patients maintain that they are more comfortable than they have been in months.

While eucupin in oil is of particular value in the treatment of pruritus ani, and the eucupin-procaine combination in saline for surgical repair of the anus, we have also employed the oily solution in a variety of rectal operations. These include superficial fragmentation of the anus, fissures, ulcers, hemorrhoids, skin tags, and perianal warts. The condensed protocols of these operations are shown in Table II.

A small amount of solution (1 or 2 c.c.), injected beneath a painful ulcer, serves to splint an irritable sphincter and allows healing to take place. Under this type of anesthesia external thrombotic hemmorhoids, skin tags, and sentinel piles can be removed and the conditions treated by methods which are applicable to ambulatory patients. It is our practice to remove chronic painful anal ulcers by wide delta-shaped excisions as an office treatment; under eucupin-oil anesthesia, dressing and dilations may be done with a minimum of discomfort to the patient. Healing has usually been accomplished by the time the anesthesia has subsided.

We believe that both the saline and oily solutions have their places in rectal surgery and in the treatment of anal diseases, and our experience with both has been quite gratifying. It does not seem advisable to resort to anesthetics in oil for prolonged anesthesia when a saline solution can be employed safely, effectively, and without the necessity of a special technique in administration. When anesthesia or analgesia of three or five days' duration is considered adequate in maintaining the post-operative comfort of the patient, further prolongation of the effects induces that possibility of trophic disturbances which sometimes result in induration and sloughing. Finally, it should be mentioned that the high bactericidal qualities of eucupin may be of value in maintaining sterility of the anesthetic solution and also of the operative field.

## SUMMARY

Eucupin dihydrochloride 0.1 per cent, with procaine hydrochloride 1.0 per cent, in saline has been found a very reliable anesthetic for minor rectal surgical procedures. Anesthesia is rapid, and is not attended by tissue reactions, irritation, or evidence of any systemic effects.

## TABLE I

EUCUPIN-PROCAINE IN SALINE

Eucupin Dihydrochloride 0.1 Per Cent—Procaine Hydrochloride 1.0 Per Cent in Saline

| Patient | Age | Pathology | Amount of Solution | Post-Operative Medication | Post-Operative Course | Duration of Anesthesia | Remarks |
|---|---|---|---|---|---|---|---|
| H. B. | 56 | Prolapsed internal hemorrhoids | 40 c.c. | None | Normal healing | 5 days | Hemorrhoidectomy |
| M. P. | 41 | Internal hemorrhoids, skin tabs | 40 c.c. | None | Normal healing | 4 days | Hemorrhoidectomy—7 day analgesia |
| E. A. | 36 | Internal hemorrhoids, anal fibroma, hypertrophied papilla | 35 c.c. | None | Normal healing | 5 days | Hemorrhoidectomy—excision of fibroma and papilla |
| G. S. | 44 | Anal ulcer | 40 c.c. | None | Normal healing | 5 days | Similar operation one year ago required hypodermic and sedative to control postoperative pain |
| B. M. | 40 | Internal hemorrhoids, ulcer and sentinel pile | 30 c.c. | None | Normal healing | 7 days | |
| E. S. | 47 | Pruritus ani, anal ulcer, internal hemorrhoids | 30 c.c. | Amidopyrine for headache | Normal healing | 4 days | Operation supplemented with spinal anesthesia. No operative pain |
| F. S. | 45 | Internal hemorrhoids, external thrombotic piles | 30 c.c. | Sedative for insomnia | Normal healing | 6 days | Gas-oxygen, supplementary |
| R. L. | 31 | Internal hemorrhoids, external thrombotic piles | 30 c.c. | Pantopon for nausea and vomiting | Normal healing | 5 days | No operative pains |
| B. B. | 27 | Internal hemorrhoids, external thrombotic piles | 30 c.c. | Phenobarbital for sleep | Normal healing | 4 days | No pain |
| E. M. | 41 | Prolapsed internal hemorrhoids | 35 c.c. | Phenobarbital for sleep | Normal healing | 5 days | Gas-oxygen at operation |
| S. S. | 59 | Prolapsed internal hemorrhoids. External skin tabs | 30 c.c. | Morphine as sedative—codeine second day | Moderate edema; normal healing | 6 days | Spinal anesthesia—no pain at operative site |
| D. L. | 56 | External and internal hemorrhoids | 30 c.c. | Codeine first night. Phenobarbital second night | Subcutaneous hematoma from needle | 3 days | Gas-oxygen supplementary anesthesia+, slight pain |
| O. A. | 54 | Internal hemorrhoids | 30 c.c. | None | Slight edema; normal healing | 4 days | Gas-oxygen, no pain |
| D. H. | 39 | Internal hemorrhoids | 30 c.c. | Morphine ¼ gr. first night at request | Normal | 3 days | Gas-oxygen, no pain apprehensive patient |

## TABLE II

### EUCUPIN IN OIL

Eucupin Base 0.1 Per Cent, Ethylaminobenzoate 3 Per Cent, Benzyl Alcohol 5 Per Cent, in Almond Oil

| Patient | Age | Pathology | Amount, C.c. | Operative and Post-Operative Pain | Post-Operative Medication | Duration of Anesthesia, Days |
|---|---|---|---|---|---|---|
| B. T. | 42 | Pruritus | 5 | None | None | 15 |
| M. G. | 32 | Pruritus | 10 | None | None | 30 |
| F. N. | 36 | Pruritus | 15 | Slight | None | 36 |
| H. M. | 50 | Pruritus | 16 | None | None | 42 |
| A. B. | 46 | Pruritus | 10 | None | None | 42 |
| C. L. | 24 | Pruritus | 12 | None | None | 35 |
| S. D. | 39 | Pruritus | 22 | None | None | 42 |
| M. D. | 62 | Hemorrhoids | 25 | None | Amidopyrine | 30 |
| M. L. | 34 | Hemorrhoids | 15 | Slight | None | 28 |
| G. H. | 35 | Hemorrhoids | 25 | Slight | Acetylsalicylic acid | 36 |
| L. K. | 24 | Hemorrhoids (external) | 10 | None | None | 28 |
| C. S. | 25 | Hemorrhoids (external) | 5 | None | None | 23 |
| C. F. | 36 | Hemorrhoids (external) | 10 | Slight | None | 28 |
| F. G. | 38 | Hemorrhoids | 15 | Slight | Amidopyrine 5 gr. | 28 |
| B. W. | 42 | Hemorrhoids | 20 | None | None | 28 |
| O. G. | 26 | Fissure | 4 | None | None | 24 |
| T. D. | 45 | Fissure | 15 | Slight | None | 28 |
| M. W. | 26 | Fissure (A.) | 5 | None | None | 30 |
| L. C. | 44 | Fissure (A.P.) | 10 | Slight | None | 21 |
| T. H. | 19 | Fissure | 5 | None | None | 18 |
| M. K. | 19 | Fissure | 5 | None | None | 21 |
| S. D. | 12 | Fissure | 6 | None | None | 24 |
| L. R. | 24 | Fissure | 15 | None | None | 30 |
| F. N. | 23 | Fissure | 5 | None | None | 21 |
| F. C. | 30 | Fissure | 6 | None | None | 28 |
| P. B. | 21 | Fissure | 5 | Slight | None | 21 |
| L. H. | 26 | Fissure | 5 | None | None | 20 |
| Z. B. | 26 | Fissure | 5 | None | None | 24 |
| S. L. | 20 | Fissure | 6 | None | None | 21 |
| F. K. | 36 | Fissure | 8 | None | None | 30 |
| S. B. | 35 | Fissure | 5 | None | None | 30 |
| A. B. | 31 | Fissure | 5 | None | None | 20 |
| H. S. | 36 | Fissure | 10 | None | None | 21 |
| D. M. | 33 | Ulcer | 5 | None | None | 21 |
| A. T. | 28 | Ulcer | 5 | None | None | 21 |
| L. M. | 22 | Ulcer | 5 | None | None | 18 |
| S. L. | 33 | Ulcer (crypt) | 10 | None | None | 28 |
| C. S. | 40 | Ulcer (crypt) | 10 | None | None | 24 |
| D. K. | 35 | Ulcer (anal) | 4 | None | None | 28 |
| D. F. | 43 | Ulcer (anal) | 5 | None | None | 21 |
| S. B. | 26 | Perineal wart | 2 | None | None | 14 |
| T. G. | 34 | Diagnostic | 5 | None | None | 14 |
| C. L. | 29 | External skin tabs | 5 | None | None | 24 |
| D. S. | 25 | Spastic anus | 5 | None | None | 28 |
| L. F. | 44 | Spastic anus | 5 | None | None | 18 |
| M. T. | 26 | Cyst (pilo) | 10 | None | None | 42 |
| E. N. | 40 | Stricture (anal) | 10 | None | None | 21 |
| S. F. | 40 | Abscess (crypt) | 6 | None | None | 21 |
| O. S. | 40 | Fistula (crypt) | 20 | None | None | 21 |
| N. C. | 32 | Fistula | 10 | None | None | 40 |

The anesthesia and postoperative analgesia produced by this combination persist from three to seven days without the addition of epinephrine.

The employment of this solution requires no special technique or consideration, and it can be used to maintain prolonged regional anesthesia as a supplement to inhalation, spinal, or intravenous anesthesia. No evidence of delayed healing has been encountered.

Eucupin in oil, like other anesthetics of this type, requires special technique in its use to avoid pooling. The formula has been employed successfully in a variety of anal conditions both for treatment, and for surgical repair.

Its greatest value, we believe, is in the treatment of pruritus ani, as the infiltration may be repeated a number of times, as the condition demands. The analgesic effect of a single injection usually persists from two to six weeks, and when the substance is properly used, local tissue reactions are rare.

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# SUPERVOLTAGE X-RAY THERAPY

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ROENTGEN rays, as used therapeutically, have been commonly classified as of low, medium or high voltages, when generated by about 100,000, 150,000 and 200,000 volts respectively. The term "supervoltage" is of recent origin, and has been applied to *x*-rays generated by voltages from 400,000 to 1,000,000.

If one were to be misled by certain newspaper publicity, it would appear that, with the advent of a millennium of kilovolts in Roentgen therapy, had come the millennium in cancer cure.

At the outset, let us acknowledge the achievement of producing generators and *x*-ray tubes that will operate at 1,000 K. V. Yet it is to be regretted that nowhere in connection with the attendant publicity has there appeared even a modest intimation to the effect that while it is hoped that there would be a measurable advance in the treatment of cancer by their use, nevertheless the character of the clinical results that would follow were unknown. Every physician must hope, of course, that the expectations aroused by the use of supervoltage *x*-ray generators will not prove a tragic disappointment to cancer sufferers. For this reason alone, aside from any ethical considerations, it does seem as though the place to decide the merits of the case is not in the public press but in accredited medical journals.

*X*-rays in the low voltage range are used chiefly in superficial dermatoses. Those produced by medium voltages are employed usefully in the treatment of certain skin cancers and benign inflammatory conditions. Some therapists employ them in the treatment of relatively deep-seated neoplastic disease, but the method is time consuming and its value questionable. Voltages of about 200,000 are considered more desirable in the treatment of deep-seated cancerous growth.

The trend to the type of apparatus producing supervoltage has been due, among other things, to the greater intensity of radiation obtained thereby, permitting the utilization of more *x*-rays of shorter wave length and greater penetrating power, resulting in a larger depth dose with less skin effect under appropriate conditions. While the *x*-rays so produced are of even shorter wave length than heavily filtered gamma radiation, there is no definitive evidence that wave length per se has any specific effect. As far as is known, it is the amount of radiation absorbed that produces tumor regression. Irrespective of wave length the amount of radiation that may be administered to a human being is that amount that may be given without irreparable damage to normal tissues. To say that a 1,000,000 volt *x*-ray machine produces *x*-rays with an intensity greater than all the available radium in the world is therefore to confuse the issue and mislead the unwary. Whether one discusses radium and its gamma rays or *x*-rays of 200 K. V., 400 K. V., or 1,000 K. V., it must be under comparable conditions. It is illogical to compare the doses of radiations of different quality unless the other factors are kept constant. The dictum still holds that cancer may be cured by surgery, radium or *x*-ray, singly or in combination. Localized new growths that are accessible may be extirpated permanently by either surgery, radium, or *x*-ray. Each of these methods, however, has its limitations.

Someone has said, "However far medicine may develop as a science, the successful treatment of the sick will always be an art." Science has progressed and expanded

marvelously in the past few years, and it has made possible the facilities that we now have for treating cancer. Its dramatic strides have so enthralled us that there exists a growing tendency to attach undue importance to the servant Science and forget the mistress Art without whose adaptations of scientific discovery for human use the greatest of scientific triumphs would be of no avail.

If art is the application of knowledge to the human needs and desires, it follows that the practice of radiation therapy can only be an art when it correlates what it has received from the physicist with what clinical experience and medical science have taught it about the human body in health and disease. The study and evaluation of the various properties of radiation have taken place almost simultaneously with the development of radiation therapy. The therapist, groping empirically for better control of his medium, has constantly appealed to the physicist for definitions and units with which to record his progress. The physicist, whose code and training admit of no limits to precision, has responded nobly, but has produced a language which, when written, "has the appearance of modern Greek with a few idiographs from the classical Persian." This is readily translatable to the mathematical expert, but has, I believe, limited direct application to the treatment of cancer. It is not the intention of the writer to minimize the importance of scientific study. It is his desire to indicate the error of leaving the path of clinical experience to follow the physicist too far along the road paved with fascinating numbers. A surgeon may possibly have a slide rule, but he must also have a scalpel.

It may be profitable to consider briefly the development of radiation therapy and its modern theory and method of application. During the earlier days, radiation was applied at one seance, sometimes of several hours' duration. This resulted in improvement in some cases, failures in many more. The failures were attributed to insufficient treatment, and the tendency was to try even greater quantities of radiant energy. This tendency was checked by the occurrence of unpleasant and dangerous systemic reactions, nausea, hemorrhage, and severe local destructions of tissue.

It was thought that the systemic reactions were to some extent unavoidable and perhaps necessary; but most radiologists were forced to divide their treatments. This corrected the systemic effect somewhat, but did not lessen the danger to the skin and subcutaneous tissues, and the danger was really increased. No longer inhibited by symptoms which became quickly apparent, the radiologist did not hesitate to apply even larger quantities of energy than before, so that serious skin damage resulted months and even years later. There was some increase in the number of cases improved by this method, but there were still many failures. Nevertheless, the belief held that the failures were due to insufficient treatment.

During these times there was great pressure for the establishment of a standard of measurement more accurate than that previously employed to describe dosage. It was felt that there was some upper limit to the amount of radiation the tissues might receive without irreparable damage, and that such damage as occurred was due to inaccurate description of dosage employed and inaccurate reproduction of the various physical factors by those who were trying to reproduce clinical results.

Such a unit of intensity was finally established in the R unit, and it was then made evident that there were other factors which affected the clinical results. The first of these was the quality of the radiation or its penetrating power, which governed the distribution of absorbed energy within the tissues. Second, the size and distribution of the ports of entry took on new importance with increasing knowledge as to their relation to tumor (depth) dose and skin effect at entrance and exit of the radiant energy. Third, the manner in which the treatment was administered became of

significance, whether in one day, six days, or sixty days. It became obvious that the body tended to repair local tissue damage; the more the opportunity afforded for repair between assaults and the less the severity of the assault the greater the total intensity of radiation which might safely be given.

During this period of development, two interesting observations were made. The first was that for certain types of tumor the number of clinical improvements increased as the quality of the radiation was made more penetrating. This could be accomplished by increasing filtration. At each voltage there is a limit to which filtration may be carried without reducing intensity below the economic limit. Consequently, voltages were increased from the customary 200 K. V. to 400 K. V., 800 K. V., and higher. There is a division of opinion as to the reason for this improvement in results. By some it is attributed to better distribution of absorbed energy in the tissues, by others to some specific property of the shorter wave length.

The second interesting observation was that on certain types of tumors the result of radiation treatment seemed to depend upon the administration of larger total intensities which could be accomplished without toxemias or severe inflammatory reaction to the skin and mucous membrane by giving small treatments each day over a great number of days. This would suggest that from a certain severity of assault the recovery of the normal tissues is more rapid than that of pathologic tissues and that advantage may be taken of this differential recovery rate so that when finally the cumulative dose to the tumor may be lethal that of the intervening and surrounding tissues may be far from that point.

Coutard,[1] working with *x*-rays, extended his treatment period over sixty days. His routine was based on the experimental and clinical work of his confrère Régaud at the Curie Institute, who believed that there was a biologic reason for the clinical improvement seen in cancer patients who had been treated with protracted low intensity heavily filtered gamma rays of radium. When Coutard reduced his total daily doses to 200 R and less, with a chronologic spread out of the treatment period, he began to obtain cures of adult type carcinoma. Since his work the terms "radiosensitive" and "radioresistant" have taken on a more relative meaning than ever.

His explanation of the response of pathologic tissues to irradiation is worthy of repetition, based as it is on an intensive personal study of tumors of the larynx since 1920. He believes that the nutrition of the cells of an epithelioma during irradiation is dependent upon the conservation of the medium in which it lies, namely, the vasculo-connective tissue. If the total or daily dose, or the intensity per minute, has been too high, or the field has been too large in relation to the dose, or if the filtration or the tension has been too low, the connective tissue may be modified and thereby the nutrition of the epithelioma cells may become difficult.

The cellular radiosensitivity, which seems linked up not only with the usefulness of the cells but, above all, with the activity of their interchanges with the vasculo-connective tissue, is modified, often diminished and sometimes depressed. The cancer cells behave clinically as if they had become insensitive to the irradiation: this is what Régaud described in 1913 under the name of radio-vaccination.

In the case of a very embryonic tumor, the radiomodifications of the vasculo-connective tissue have a very slight effect upon the radiosensitivity of the cancer cells because this sensitivity is pronounced. In a highly differentiated tumor, the radiomodifications of the vasculo-connective tissue are of the utmost importance because the radiosensitivity of these tumors is feeble. In the treatment of highly embryonic, very radiosensitive cancers the energy factor seems to be a direct and rapid one, the cells dying very soon and generally

disappearing toward the twenty-fifth day. The vasculo-connective tissue seems to play only a very small part and is more often not modified after the destruction of the cancer cells.

In the embryonic cancers, a good chronologic distribution seems to insure protection to the surrounding tissue. As regards the differentiated cancers, the chronology is a different character—on the one hand, the accidents to the general tissues are exceptional on account of the long time over which the treatment is spread; and on the other hand, disappearance of the cancer cells does not happen by cellular destruction, but by a sort of late cellular evolution similar to the normal evolution. Between the forty-fifth and ninetieth days, the neoplastic masses, which have generally diminished in volume during the previous irradiations, increase anew for from eight to ten days, giving the impression of a rapidly growing recurrence; they then cover themselves with "horny" formations or glandular secretions and diminish inside again and little by little disappear. Here, Coutard says, the chronology is no longer protective, but seems rather to be evolutionary.

Practically it has been the experience in this country that if a daily dose not exceeding 200 R is used, irrespective of the R per minute intensity, the clinical results are favorable and comparable with Coutard's method when followed literally. Whatever the source of the radiant energy, whether *x*-rays or radium, the so called "Coutard method" using divided doses of heavily filtered radiation of not too great intensity with suitable calendar distribution is now rather universally employed.

With the foregoing in mind, just how does the radiotherapist of today proceed to plan the treatment of his cancer patient? His first consideration is that he is dealing with a human being and will not submit him to irradiation unless palliation at least, of his disease can be hoped for.

Having all the diagnostic information possible, he first selects the quality of radiation he intends to use. This will be determined partly by the location and accessibility of the lesion, its tumor bed, and the flexibility of the source of the radiant energy at his command. As a generalization, large sources of radiant energy, such as radium bombs and high voltage *x*-rays, may be used as sources of external irradiation. Other things being equal, there is nothing comparable to radon implants for interstitial use and the intra- and extra-cervical application of radium in the treatment of cancer of the cervix.

In localized intraoral lesions, where normal tissue can be adequately protected, radium will continue to be used. Since the introduction of shock proof high voltage *x*-ray apparatus that is flexible to handle it has been possible to treat some intraoral lesions by this method also with success. In cancer of the larynx, where high voltage external irradiation has shown its best results, there does not appear to be any good reason for going beyond 400 K. V., since the depth dose here so closely approximates the skin dose.

Emery and Mudd, working with 600 to 900 K. V., reported a series of cases of cancer of the cervix treated by external *x*-radiation alone, only to find that after apparent cure there was a prompt recurrence in the cervix. They therefore found it necessary to return to the combined method of the application of radium to the cervix and supervoltage *x*-rays. Schmitz,[4] who did not abandon the local application of radium in cervical cancer, believes that on a comparative basis his three year end results have improved since using supervoltage *x*-rays (700 K. V.).

As Murphy[3] has pointed out, supervoltage *x*-ray therapy is no guarantee against irradiation sickness, enteritis, cystitis, proctitis and all the sequelae of our earlier efforts. Fibrosis of the subcutaneous tissues has been encountered ten, twelve and fifteen months after treatment with supervoltage *x*-radiation (reputed

to be 1,000 K. V.). The essayist (the presentation was not submitted for publication) in reporting these incidents, said it was not a pleasant sight to see a patient walk into one's office at right angles.

Costolow,[2] who had the opportunity to observe 500 K. V. and 900 K. V. *x*-ray units in operation, saw no difference in skin reaction produced by the two machines, provided the same R intensity per minute, the same size field, daily dose and total days of treatment were used. Stone and Albersold,[5] comparing 200 K. V. and 1,000 K. V., demonstrate that supervoltage radiation delivers larger depth doses, the gain increasing with the depth and the decrease in the size of the field. On the other hand, in crossfire technique, the large doses on the surface of exit offset somewhat the practical value of the large depth doses. Supervoltage can be used to greater advantage if direct crossfire can be avoided, if the parts treated are thick, and if multiple small fields can be used without excessive overlapping on the opposite skin.

No five year end results have yet been published wherein supervoltage *x*-radiation has been employed. Most of the supervoltage generators have not been operated at their rated capacity because of tube difficulties. Several new 400 K. V. shockproof units, self-contained and completely flexible, are now on the market and in use. They have a range of from 250 K. V. to 400 K. V., with sufficient intensity despite heavy filtration to make them economical to operate at long distance from the time viewpoint. They also have sufficient flexibility to make them practical not only for external irradiation, but for intraoral, intravaginal, and rectal work as well.

There is no conclusive evidence at hand for the employment of supervoltage *x*-rays beyond the middle range (400 to 500 K. V.). There is, in fact, very definite evidence that supervoltages of about 1,000 K. V. may not be used profitably from a dosage viewpoint in cancer patients except under rather narrowly prescribed conditions. There is every reason to believe that radium and *x*-rays will remain complementary and of supreme value in their respective fields.

It is obvious that the radiation therapist must be abreast of progress in applied physics, with a plan of treatment based on experience, logic and common sense. His procedure must be guided at all times by judgment and clinical skill, while he himself must be on guard, alert, ready to alter or adapt his plans the instant a change is indicated by the progress of the case.

The record of radiation therapy by its very nature is likely to resemble a palimpsest in its erasures and corrections. There has been great progress in the past. If there is not greater progress in irradiation of cancer in the future, it will be because of our inability to plumb the depths of a biologic process in terms of physics.

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# SEX HORMONE THERAPY FOR PROSTATISM

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THE testicle was actually the first organ shown by experimentation to possess an internal secreting action, through the transplantation studies on capons by Berthold, in 1849. In 1889, Brown-Séquard based his ideas of internal secretions largely upon the rejuvenating and stimulating effects he observed on himself after the injection of exceedingly dilute, crude saline extracts of testis tissue. Nevertheless, it is worth noting that the actual extraction, concentration, and isolation of a testis hormone was very much delayed, while less obvious and seemingly more difficult biochemical problems of internal secretion in other endocrine organs were being solved.

Real progress on the biochemistry of the male sex hormones has come only since 1926 and especially since 1931, when the first successful method of extraction was announced. In all probability the main reasons for the delay are: (1) the lack of a chemical method for the detection of the hormone; and (2) because the studies on the secretions of the suprarenal, thyroid, and pituitary led investigators to expect a concentration of hormone in the testicle similar to that of epinephrine in the suprarenals and iodine in the thyroid. Numerous negative results had been obtained with testicular extracts because the dosage used, expressed in terms of tissue weight, was entirely too low. It is to be noted that whereas fractions of grams of fresh suprarenal or thyroid can be employed for chemical and physiologic studies, it is necessary to fractionate and concentrate the extract from testis tissue to such an extent that the daily capon dose represents 50 to 100 gm. of testis tissue (from the bull). In view of fact that one ton of bull testis tissue contains approximately 150 to 200 mg. of the pure hormone, the difficulties involved in its purification and in studies on its biologic action must be apparent.

In spite of its low concentration in the glands, astounding progress has been made in the last few years in the study of the chemistry of the male sex hormone or hormones. As a result, the numerous biologic and clinical problems which involve the testicular secretions are likely to find more accurate as well as more rapid solution. It is now much more economical to prepare the sex hormone synthetically from cholesterol (to which it is chemically related) than to extract it from testicular substance. The prohibitive cost of the latter procedure makes effective dosage impossible.

Benign hypertrophy of the prostate, often termed adenomatous prostate, has long been recognized as a disease of old men. It manifests itself clinically at an age which is sometimes referred to as the male climacteric. From every standpoint, not only that of biologic research, but also that

of sometimes treacherous deductive reasoning, one can hardly escape the tentative hypothesis that, in a large percentage of cases, benign hypertrophy is a deficiency disease. The biologic studies include experimental parabiosis, assays of purified extracts and chemically pure crystalline hormones on animals, synthesis and much experimental research. The biologic assays, quite apart from the recent chemical determinations, were, for the most part, based on experiments on birds (capons) and rats. Such assays were interpreted as bird units (b.u.) or rat units (r.u.). The relationship between the bird unit and the rat unit varied markedly, presumably due to other factors, the explanation of which has not yet been agreed upon by the various investigators.

Deming[1] and his co-workers, in particular, after considerable research, have concluded that benign hypertrophy has its origin in two separate and distinct anatomic structures, the prostatic lobes and the submucous glands. Their observations lead them to the belief that prostatic enlargement due to hyperplasia of the submucous glands is in no way caused by hormone disturbance or imbalance, and that it cannot be affected by the administration of sex hormones. Since they offer no conclusive proof, however, these conclusions are not universally accepted. On the other hand, many admirable researches in America and Europe by responsible and authoritative scientists and clinicians seem to show that sex hormone therapy may bring about a quite definite clinical improvement in patients whose prostatism is not too far advanced, and in an exceedingly small percentage of cases there may apparently be actual diminution in size. Only time and collective experience will disclose how much real value can be attributed to such therapy.

Not until the testicular hormone was isolated in a pure state, the exact chemical structure established and the hormone prepared synthetically, was it feasible to assay preparations for sex hormone value. For example, Lower[2] states in discussing his own product, which he calls inhibin, that it cannot be assayed. In spite of persistent efforts, no suitable method for such evaluation seems to have been reported by Dr. Lower and his co-workers in their publications to date. For this reason it has been impossible to determine what chemical fraction of the testis contains inhibin, and it is equally impossible to know whether or not all preparations of the so-called inhibin are of the same strength, or what dose of hormone each patient receives. Koch[3] is of the opinion that inhibin is not a pure substance, but simply an extract which probably contains diminutive and varying amounts of the hormones. The Council on Pharmacy and Chemistry of the American Medical Association reports in the issue of the Journal for July 18, 1936 (page 212), declares that, "A further hypothetical substance from the testicle, believed to emanate from the germinal epithelium and to act quite specifically on the pituitary gland has been called by McCullagh 'inhibin.' It is still questionable whether such a substance exists." Nevertheless, Dr. Lower has obtained undoubted clinical results comparable with those of Van Capellen,[4] Zuckerman and Greene,[5] Laqueur[6] and others. Hence, inhibin seems to have had considerable potency in actual clinical practice.

Most of the sex hormone preparations on the market or experimentally investigated have been without value. Besides inhibin, almost the single exception until recently was Leo Stanley's testicular mush, which was injected in the abdominal wall superficial to the rectus fascia. Stanley's procedure was unquestionably effective in overcoming sex hormone deficiency in many cases. About twelve years ago, a nationally famed New England scientist and educator (not a doctor of medicine) spent some time investigating Dr. Stanley's work at San Quentin Prison at first hand and made a number of interesting observations which have not been published, but which he related to one of us. He found, for example,

that occasionally an aging man could temporarily discard his spectacles after one or more of these Stanley injections. The obvious explanation was the partial toning-up, so to speak, of the iris muscle. An analogous and sometimes accompanying phenomenon was the increased tone of the accelerator urinae muscle, enabling an aged man to more nearly empty the bulbous urethra of the last few drops of urine which otherwise dribbled and stained his underwear. The same effect on the erector muscles of the penis not infrequently gave the patient a feeling of mild rejuvenation.

This apparent increase in muscular tone is important to bear in mind, since some of the clinical improvement in prostatics noted by Lower, Van Capellen, Zuckerman and Greene, Laqueur, and many others, may be due to improved tone of the trigonis muscle whose function is to depress the posterior lip of the vesical orifice and thereby open it so that the detrusor muscle can expel the urine. This possible interpretation is especially important because Lower and a majority of the other authoritative investigators state that they could not definitely claim that the prostate was reduced in size in any of those prostatics treated with sex hormones, although there was marked clinical improvement in about 65 per cent of the uncomplicated and not too far advanced cases. The improvement was especially manifest as regards nocturia, frequency and residual urine.

Two testicular hormones have been isolated in pure crystalline form, androsterone and testosterone, whose exact chemical constitutions have been determined and which have both been prepared synthetically, together with a number of intermediate substances. Testosterone is possibly derived from the interstitial cells of Leydig, and androsterone supposedly from the spermatogenic cells of the tubules. There is much confusion among the investigators as to the origin of androsterone —as to whether it represents a stage in the biologic synthesis of testosterone, an early degradation product of testosterone, or a product identical with one of the hormones of the hypohysis.

It is apparently also true that certain of the secondary sex organs, notably the prostate, seminal vesicles and mammary glands, are excited to hyperplastic growth by estrin or estrogenic substances, by a hormone from the hypophysis and possibly by intermediate hormonic substances.* This hyperplasia, due to hormonic imbalance, is readily overcome by testosterone, the true hormone, administered intramuscularly. Coming to practically the same conclusion, Laqueur of Amsterdam has become convinced that in prostatic hypertrophy there is an improper balance between the male and the estrogenic hormones at the root of the abnormal changes. In a normal male under the prostatic age, the *two* sex hormonic substances are presumably in balance, and also in balance with the hormones of the pituitary and adrenals. When benign hypertrophy occurs, it is believed with much reason that the testosterone is deficient and the hyperplastic action of the estrogenic and other gonadotropic substances is not properly inhibited. An excess of estrogenic hormone has been apparently proved by biologic research to bring about hypertrophy in certain animals, which hypertrophy disappears after injections of testosterone.

In the main our clinical results practically parallel those of Lower, Van Capellen, and Laqueur, and show some clinical improvement in about 50 per cent of carefully selected patients, whose residual urine did not exceed 100 c.c. Most of our observations during the past fifteen months have been based on the clinical use of the synthetic Ciba preparation testosterone propionate, marketed under the trade name of perandren and now available on a commercial scale. The preparation is dissolved in oil of sesame and is altogether

* It has been shown that androsterone is not estrogenic, but that estrone (and perhaps other estrogenic substances) is a normal constituent of male urine. The urine of stallions is particularly rich in this substance.

non-irritating when injected intramuscularly. We have used more than 500 ampoules in more than 40 patients.

Use of this hormone is frequently invaluable in very feeble and very old men to tide them over certain emergencies such as cystostomies or other surgical procedures, which may be imperative. The clinical response is sometimes very striking. It may be used, we believe, to excellent advantage in castrates. One of us had occasion to observe a young man who was dragged by a run-away truck, an accident which resulted in the complete loss of both testicles. For months the individual maintained a pulse rate of 110 to 120 in association with a definite psychoneurosis. Injections of Stanley's testicular mush were followed by striking improvement in his symptoms, the pulse rate dropping markedly, and the psychoneurosis showing great regression. Finally, testosterone is efficient in a percentage of patients with varying degrees of impotency, although it is questionable whether or not the injection of Stanley's testicular mush is not more effective in its action on this particular type of patient.

An immense literature has grown up around this subject during the past few years. The authors have reviewed more than sixty articles on the subject and append references to a fair cross-section of these.

## CONCLUSIONS

1. The use of testosterone is seemingly effective in bringing about clinical improvement in a large percentage of patients with benign prostatic hypertrophy, in inhibiting hyperplasia and holding it in check at least temporarily.

2. Its use is still in the experimental stage and infinitely more clinical and experimental data are necessary before definite conclusions can be ventured. There seems no present known objection, however, to its extensive clinical use in an effort to determine what, if any, therapeutic value it has in inhibiting prostatic hyperplasias if not too far advanced.

3. It may prove useful in any case where there is reason to believe there is a sex hormone deficiency.

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# RECURRENT AND CONTINUING HYPERTHYROIDISM*

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EARLIEST records show that goiter is probably as old as the human race, since it is mentioned in some of the first literature. In some of the very early Hindu collections, dating back 2000 years before Christ, there is considerable reference to goiter as a disease. It is only during the last century that the importance of goiter as a sociological problem has become officially recognized.

In the year 1878, Theodore Kocher was reported to have done the first therapeutic excision of the thyroid gland. His name, and that of Charles H. Mayo and William H. Halstead, were prominent in the early development of surgical treatment of this disease.

Since the first thyroidectomy, the technique of operation on goiter has been gradually improved and perfected. About the beginning of the last decade, most centers of population where goiter was prevalent had one or more surgeons who made a particular study of the problems involved in the surgical cure of this disease, and had perfected themselves in its handling. It was natural to expect that, with these individuals devoting their time and energies to study and perfection of their technique and judgment, uniformly good results would ensue. This was quite generally true, with the exception of diffuse toxic goiter or Graves' Disease, where the mortality rate and the percentage of cures was far from satisfactory.

In 1921, Plummer brought forth his epoch-making treatment of this disease with compound iodine solution. He first advocated the use of Lugols' solution in the preparation of these people for operation, and later showed that its use post-operatively was the best insurance against further trouble. From that time on the mortality rate dropped markedly, and the percentage of cases not considered cured was greatly reduced.

As early as 1928, J. E. Else,[1] writing from the Department of Surgery at the University of Oregon, noted the increasing tendency of the profession as a whole to attempt thyroid surgery. He stated that formerly most of these operations were done by surgeons having a special interest in goiter. The ability of these men had produced excellent results, through intensive training and study of this disease and its surgical treatment. However, in recent years, general surgeons, general practitioners, and the occasional operator were attempting goiter surgery. His observations seemed to show quite definitely that during these years there had been a decided increase in the number of patients requiring secondary operations for goiter.

Gradually surgeons as a whole and even general practitioners have stepped into the role of goiter surgeons regardless of their particular fitness. Many of these men are extremely capable and have perfected themselves in the various problems of technique and judgment involved in the handling of these cases. However, there has been an increasing tendency for a considerable group of men to attempt surgical cure without sufficient knowledge, judgment, or training. The results have become obvious. There has been an increasing number of cases of goiter operated which have not been cured, particularly in the diffuse toxic group. The number of true recurrent goiters, meanwhile, has shown a decrease, as would be expected.

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In March, 1931, Buchbinder[1] from the Richter Clinic in Chicago reported nineteen recurrences in 582 consecutive thyroidectomies, or 3.3 per cent. In this clinic it is believed that the largest percentage of cases requiring second operation is due to incomplete or insufficient primary thyroidectomy. He states that removal of a moderate amount of thyroid tissue does not in any sense of the word constitute a thyroidectomy. The general feeling among surgeons who are most interested in surgery of the thyroid, is that diffuse toxic goiter in which there has been a complete cure shows very little tendency to recur.

Pemberton,[3] on the contrary, writes on this subject from an opposite point of view. He believes that it is a common error to consider inadequate surgery as the cause of recurrence. This is true, but it is not an error to presume that insufficient surgery is the most common cause of so-called persistent hyperthyroidism. He further states that, as a result of this belief, there has been a tendency toward more radical surgery with an increase in such devastating complications as injury to the recurrent laryngeal nerves and the parathyroid bodies. He states that in conservative resection recurrence should not be over 5 per cent. This appears to be too high a figure when compared with other series of cases. Here again it is important to differentiate between true recurrence and failure to cure. In 1683 cases he shows a percentage of recurrence of 2.9 per cent. This figure, apparently, does not include cases of recurrence treated medically or by *x*-ray, or those cases in which the patient went elsewhere for the secondary operation.

Jackson[4] reports 722 operations in cases of diffuse toxic goiter with seventeen cases of persistent hyperthyroidism and thirty-six cases of recurrent hyperthyroidism.

That statistics as a whole show such a large group of so-called recurrences may be due to one of several factors:

1. Incomplete or insufficient operation due to inexperience on the part of the operator.

2. Anatomical variations not recognized at the time of operation. These would include aberrant thyroid tissue, pyramidal lobes, superior accessory lobes, retrotracheal, lateral and inferior extensions, or substernal lobes.

3. Improper preparation and follow-up of these cases.

J. E. Else[5] in his article in 1930, writing on recurrence in diffuse toxic goiter, dwells on the importance of saturation of the gland with iodine preoperatively and for a period of two to three months postoperatively. The further study and follow-up of this type of case over a period of two or three years with examinations at definite intervals plus basal metabolic studies assumes real importance.

Pemberton reports 100 cases of diffuse toxic goiter recurring at the Mayo Clinic. The average time before recurrence of symptoms was 5.4 years, the longest twenty-one years. The average interval between operations was 6.6 years. Of these 100 cases, twelve recurred in twelve months. Nine patients were never entirely symptom free. In three cases a definite hypothyroidism was produced after the first operation, and yet recurrence developed.

Speaking strictly of diffuse toxic goiter, we must recognize the fact that the disease is not one primarily of the thyroid gland. Thyroidectomy serves somehow to break a link in the chain of pathological circumstances which brought about the onset of this disease. It is possible that if any viable thyroid tissue remains in the body, the stimulous or driving force behind the thyroid, which occurred to produce the goiter in the first place might again become active and further stimulate the remnant of thyroid tissue producing the same clinical results.

It is known that this stimulus comes through the cervical sympathetic nervous system, and that degenerative changes are produced in the cervical sympathetic ganglion. The possibility of the same stimulation causing a further development of thyroid intoxication is questionable. It

would seem that with proper surgical intervention at the time of the original thyroidectomy, these sympathetic nerve fibers would be definitely removed at their point of entrance through the superior pole and could no longer produce the same stimulation.

Pemberton believes that removal of 65 per cent to 85 per cent of gland tissue in the average case is sufficient. For those conversant with surgery of the thyroid, it is apparent that each case is a problem in itself. It is impossible to set up any standard accurate gauge covering all cases indicating the amount of thyroid tissue to be removed. In any case sufficient gland should be removed to interrupt the course of the disease, and enough gland should be left to carry on the function of the thyroid. Obviously, protection of the contiguous structures is imperative. This must be constantly in mind in any radical type of thyroidectomy.

In 1934, Haines and Pemberton[6] stated that 25 per cent of all recurrences could be satisfactorily controlled by iodine alone. They reported three cases in which a definite recurrence was controlled by the removal of one gram or less of thyroid tissue. In each of these three cases the so-called recurrence, however, was from two to six weeks following the original operation. The time elapsed would indicate that these were not recurrences but rather persistent cases of hyperthyroidism.

In an effort to arrive at some fairly accurate findings in regard to the results obtained by a cross section of the profession as a whole, a study has been made of all thyroidectomies done at St. Mary's and St. Luke's Hospitals in Duluth from the years 1926 to 1936 inclusive.

During these years there were 2064 thyroidectomies performed. Out of the total number there were fifty-six cases requiring further thyroid surgery, or 2.71 per cent. Forty-eight of these had a second operation, or 2.32 per cent. Seven had three operations, or .33 per cent; while one had four or .04 per cent.

In the group of fifty-six cases re-operated there were sixty-four thyroidectomies; forty-two of these were done by four surgeons. This meant that approximately two-thirds of all the cases that had to be reoperated fell into the hands of these men for their second operation. The primary operations in this group were done by thirty-five individual surgeons or practitioners. The remaining twenty-two cases were operated secondarily by fifteen different surgeons.

In the group of fifty-six cases studied there were twenty-one cases of recurrent nodular goiter and thirty-two cases of diffuse toxic goiter identified by pathological specimens. Of the three remaining cases, one showed nodular goiter at the first operation, and diffuse goiter at the second; one, diffuse at the first and nodular at the second operation; and the third was definitely a case of thyroiditis.

For the purpose of this paper this study will be confined to the fifty-three cases; twenty-one of nodular goiter and thirty-two of diffuse toxic goiter. A statistical summary is of interest. In the first group, or that comprising the nodular goiters, the average age at recurrence was 41.1 years, the oldest patient at the time of recurrence was 66 years, and the youngest was 14 years. The average time elapsed since the preceding operation was 10.2 years; the longest time twenty-five years, and the shortest one year.

There were three cases who had three operations. The average time elapsed since the first operation was thirteen years. There was one case that had four operations; the first being ten years previously. The average time of recurrence of symptoms before the last operation was 2.2 years while after the preceding operation it was 7.7 years. The average weight of the glands removed at the original operation was 94 grams. The mean measurements were $9 \times 6.1 \times 4.1$ cm. At the second operation the weight was 101 grams, and the measurements were $9.6 \times 6.4 \times 4.8$ cm.

In nodular goiter we must take into consideration the fact that in many of these glands small adenomata may be scattered throughout the gland tissue and that in the stump remaining there may be numerous nodules too small to palpate. It is reasonable to assume that these nodules may grow as time goes on and develop into good sized nodular goiters. Undoubtedly there are a certain number in this group that owe their recurrence, partially at least, to failure to recognize inferior extensions into the chest cavity or extensions behind the trachea. Improper elevation of the gland at the time of the initial operation will fail to disclose many of these extensions. If these are not recognized and removed, the operation is incomplete.

Recurrence of nodular goiter is apparently a true recurrence as a considerable period, 7.7 years, elapsed before the reappearance of symptoms and 10.2 years before coming to secondary operation. The average pre-operative basal metabolic reading before the second operation was 29.5.

There were four cases of vocal cord paralysis in this group. In one there was aphonia with a brassy cough in which no examination of the cords was made. One case had no movement of the cords with adductor paralysis. The third and fourth cases had right cord paralysis. There was

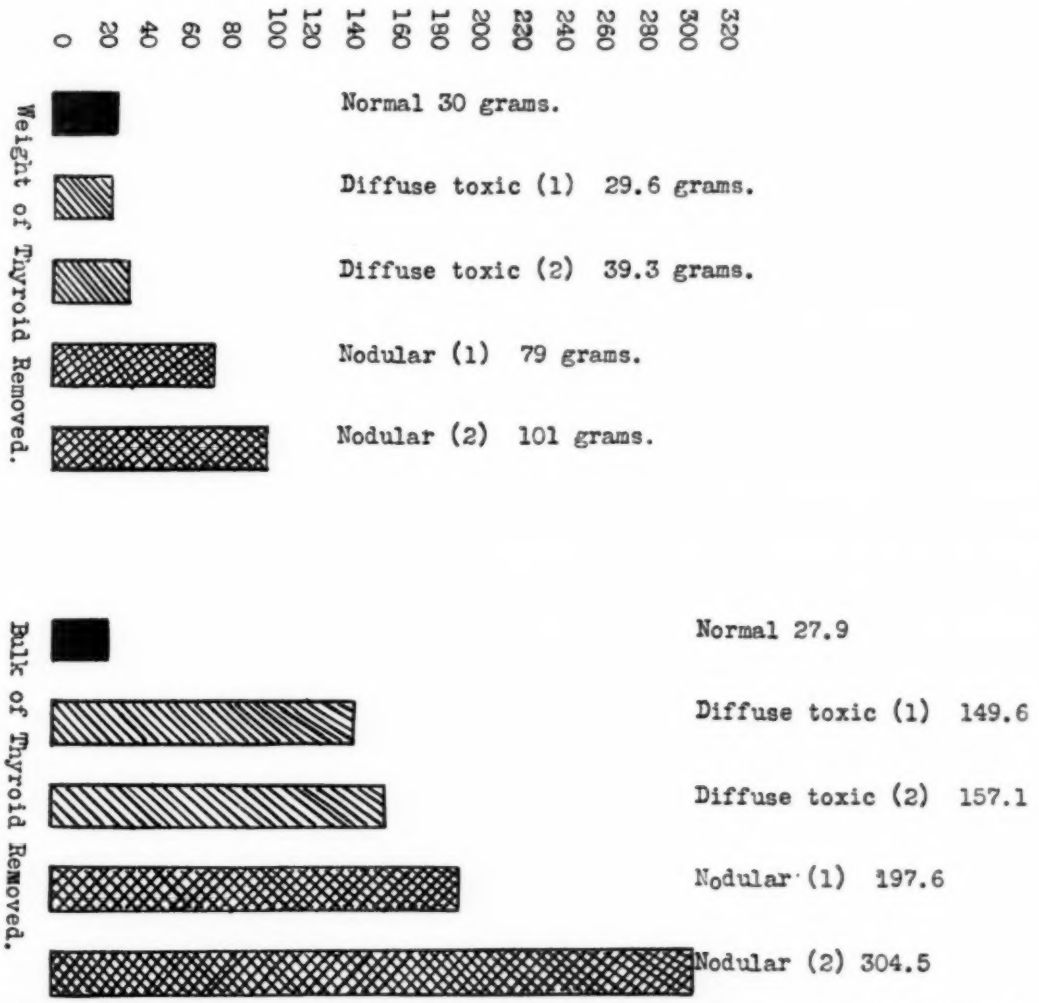
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320
Weight of Thyroid Removed.
Normal 30 grams.
Diffuse toxic (1) 29.6 grams.
Diffuse toxic (2) 39.3 grams.
Nodular (1) 79 grams.
Nodular (2) 101 grams.
Bulk of Thyroid Removed.
Normal 27.9
Diffuse toxic (1) 149.6
Diffuse toxic (2) 157.1
Nodular (1) 197.6
Nodular (2) 304.5

Fig. 1. Relative weight and relative bulk of normal thyroid glands compared to weight and bulk of gland tissue removed in diffuse toxic and nodular goiters.

one case of questionable tetany and one case of surgical shock which recovered.

In all of the articles reviewed, the discussion on recurrence or persistence of goiter was confined entirely to diffuse toxic goiter. In this series, 34.49 per cent were in the nodular type goiter, indicating that a much larger percentage of recurrence is found in this type than we had formerly believed. How best to avoid recurrence in adenomatous goiter is worthy of consideration. It is necessary to ascertain that there are no substernal projections not recognized and removed. This is done by careful elevation of each lobe and careful finger explorations. It will also insure against leaving any lateral or retrotracheal extensions. The isthmus should be entirely removed, and examination should be made for a pyramidal lobe, which, if present, should also be excised. The remaining gland tissue should be carefully examined to ascertain, as far as possible, that all nodules, no matter how small, are removed.

The recurrence and persistence of diffuse toxic goiter, about which so much has been written, is an entirely different problem than in nodular goiter. In these cases the term persistent goiter has been applied to those cases in which no relief, moderate relief, or a short period of relief existed. It is reasonable to assume that in those cases where relief has not been present for a period of one year or more, the case could not truly be considered as recurrent, but would rather fall into the group of persistent, pseudo-recurrences or residual goiter. These three terms have been applied to this condition by different authors writing on this subject. It does not seem that they quite express exactly what has happened in failure to produce a cure by operative treatment. The suggestion is made that the term "continuing goiter" more adequately expresses the idea, that this goiter has not been cured by surgical interference. This is entirely different than the group of goiters that have been definitely cured and at some later date have recurred.

In this series of thirty-two cases of diffuse toxic goiter in which secondary operation was performed, the average age was 38.2 years at the time of the second operation, the oldest 62, and the youngest 20. These patients had their primary operation an average of 3.4 years before the second operation. The longest was fifteen years; the shortest, four months. Of this group seven cases represented true recurrences, and symptoms recurred an average of 2.7 years following the first operation. Twenty-six cases represented the group in which no relief was present or in which the relief was transitory. These are truly cases of "continuing goiter." This group had an average recurrence of symptoms in 3.1 months. Eight cases, or 25 per cent, were not relieved at all, and the longest apparent relief obtained was eight months. The average weight of the gland removed at the first operation was 29.6 grams, while the average weight of the gland removed at the second operation was 38.3 grams. The gland tissue removed at the first operation had average measurements of $8.5 \times 5.5 \times 3.3$ cm. The mean measurements of the gland removed at the second operation was $9.1 \times 5.4 \times 3.6$ cm. The mean basal rate before the first operation was plus 43, while that prior to the second operation also showed an average of plus 43.

In this group of recurrent and "continuing" diffuse toxic goiters there were a number of complications and one death. It was apparent, through a study of the history in the case that died, that death was probably due to insufficient preparation, and that thyroid crisis developed. There were six cases or 12.5 per cent that apparently had injury to the recurrent laryngeal nerve. In some of these cases no examination of the cords was made. The first patient had a definite aphonia with a brassy cough. The second had persistent hoarseness. The third had hoarseness with a whispering type voice. In the other three

cases, examination of the cords was made. Two of these showed a right cord paralysis, and one no movement of either cord, with an adductor paralysis. 6.2 per cent then, had a proven cord paralysis. One case had a questionable tetany with spells of weakness, rapid pulse, and cramping of the fingers. Another developed surgical shock with collapse after returning to the room.

In this series there has been an unusually high percentage of complications, particularly as referred to injuries to the recurrent laryngeal nerve. There are two reasons for this: (1) The fact that in all secondary operations there is much scar tissue and that the normal position of the gland may be distorted. The recurrent laryngeal nerve may, because of scarring, lie in an abnormal position, or be actually caught in the scar tissue. (2) The eagerness on the part of the surgeon to produce a complete cure has led him to do a more radical type of operation, leaving a very small amount of gland. With less gland to protect the nerve, the danger of injury is of course much greater.

One case of diffuse toxic goiter that has had three thyroidectomies with two re-

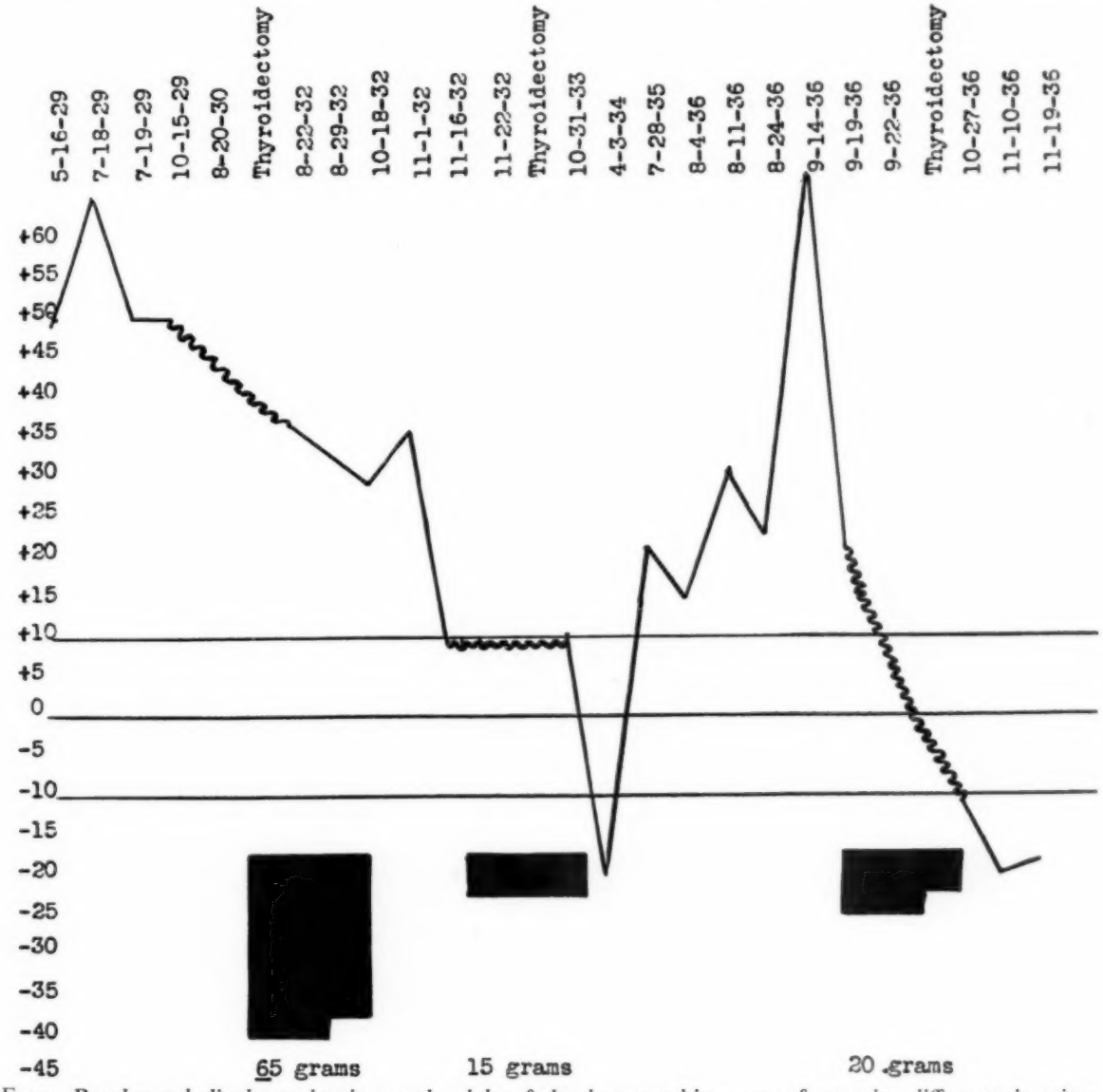


Fig. 2. Basal metabolic determinations and weight of gland removed in a case of recurring diffuse toxic goiter.

currences will be reported briefly. The patient was a youth 17 years of age. His original history was that of the usual typical diffuse toxic goiter in a young individual. Quite complete basal rates were kept throughout. The accompanying chart shows the response of the metabolism to each thyroidectomy, and corresponded accordingly with the clinical findings. Unfortunately, he did not return for his first post-operative metabolism for twenty-five months. At this time it was already elevated to plus 36, whereas his clinical course indicated that he had a period prior to this when it was undoubtedly normal. The two metabolisms taken after his second operation show very nicely the drop following thyroidectomy. His third thyroidectomy, done with the purpose in mind of making him definitely myxedematous, shows the marked response, which seems to be permanent. At present he is taking small doses of thyroid extract. The blocks in the lower part of the diagram show the amount of thyroid tissue removed at each operation; 65 grams at the first, 15 grams at the second, and 20 grams at the third.

The most outstanding finding in a review of this group is the relatively small number of cases that represented true recurrences. As has been stated, only seven cases definitely came under this classification; whereas twenty-six cases had little or no relief, or the relief was transitory. These must be considered as cases of "continuing hyperthyroidism" in which surgical intervention did not produce relief. It is also interesting to note that both the size and weight of the gland removed at the second operation averaged more than the size and weight of that removed primarily. It is reasonable to assume in this group that these patients had insufficient surgery and that though a certain portion of the thyroid was removed, the amount remaining was too great to obtain a cure of the disease.

Next to insufficient surgery, the outstanding neglect is the failure to properly follow-up and study these cases post-operatively. Frequent post-operative examinations with metabolic studies, plus the constant saturation of the gland with Iodine over a period of several months, seems to be the best insurance against recurrence.

It would seem that from the results of this, study a warning to the general practitioner or the occasional operator of goiter would not be out of place. It is not unreasonable to assume that if a real thyroidectomy is not done, the number of cases of "continuing goiter" will be on the increase. The surgeon must be on the look-out for extraneous contiguous anatomical variations. The thyroidectomy must be sufficiently complete to definitely interrupt the course of the disease, and the extreme importance of protection of the recurrent laryngeal nerves and parathyroid glands must be constantly kept in mind.

## SUMMARY

The results of this study would indicate:

1. That a much larger percentage of recurrence of goiter than was formerly suspected is found in the group of nodular goiters.

2. That the number of cases of true recurrences and "continuing goiter" is on the increase, due to the fact that this disease is being treated more generally by the profession as a whole, and that fewer cases are being handled by surgeons who have made a particular study of this disease.

3. That an unreasonably large percentage of the cases of diffuse toxic goiter coming to second operation are not recurrent, but are cases of "continuing goiter," due chiefly to an inadequate operation plus insufficient post-operative follow-up care.

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"Inflammations of the parotid most generally follow some acute disease; formerly it was typhoid fever, but now general sepsis is the commonest cause; seldom is it due to stone in the duct."

"In rare instances epithelial tumors appear in the neck when no primary tumor can be demonstrated. . . . Given a tumor of the neck, if careful examination fails to reveal a primary tumor, the neck tumor must be assumed to be primary and removed as such."
From—"Surgical Pathology of the Diseases of the Neck," by Arthur E. Hertzler (Lippincott).

# OBSERVATIONS ON SOLUTIONS USED FOR INJECTION TREATMENT OF HERNIA*

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OF major importance in the injection treatment of hernia is the solution used for the injection. Such solutions must fulfill certain requirements if success is to be attained with this therapeutic procedure. Four criteria must be followed in their evaluation: (1), the ability of the solution to produce fibrous tissue when injected into the muscles of experimental animals; (2), the determination of its toxicity when injected into the peritoneal cavities of experimental animals; (3), the determination of the sterility of the solution by bacteriologic means; and (4), the clinical evaluation of the solution on patients with hernia.

A satisfactory solution is one which will produce fibrous tissue in muscles to insure closure of the hernia. This is best determined by the use of experimental animals. Such a solution must be relatively nontoxic when injected intraperitoneally, and must be sterile.

These four criteria have been applied to three solutions which have been used in a series of 225 cases of indirect and direct reducible inguinal hernia at the Mount Zion Hospital. The results of experimental work on solution "A" have been previously reported.[1] It is the purpose of this communication to report the results of further experimentation on solutions "B" and "C."[2]

## DESMOPLASTIC REACTION

Identical experiments were made with each of the three solutions, "A," "B," and "C." Normal guinea-pigs were injected with 0.5 c.c. of the solution into the thigh muscles, and sections were taken at 6, 12, 18, 24, 48 and 72 hours, and 7, 14, 30, 75 and 300 day intervals. The solution was injected throughout the entire muscle of the thigh in order to give uniform infiltration. The specimens were obtained by disarticulation of the leg at the hip and the entire leg was fixed in formalin. The muscles of the leg were cut transversely into thin, separate blocks so that the entire leg was embedded in paraffin and sectioned. Several sections were cut from each block so that a total of over 500 sections were used in this study. These were stained with hematoxylin and eosin, and with a modified Masson's stain for connective tissue. The total number of guinea pigs used was sixty-eight.

## RESULTS WITH SOLUTION "B"

*At 6 Hours.* The muscle shows extensive edema with a diffuse polymorphonuclear leucocytic infiltration, which is particularly prominent between the muscle

[1] HARRIS, F. I. and WHITE, A. S. The injection treatment of hernia. *Surg. Gynec. and Obst.*, 63: 201–211 (Aug.) 1936.

[2] Solution "A," Pina Mestre solution; solution "B," proliferol; solution "C," sylnasol.

* From the Department of Pathology, Service of Dr. G. Y. Rusk, and the Research Laboratories, Director, Dr. Charles Weiss, Mount Zion Hospital.

bundles, and diffuses around the fibrils. In these regions the muscle fibers are undergoing dissolution with vacuolization of the sarcoplasm and pyknosis of the sarcolema nuclei. The lesion is of a patchy nature, some groups of muscle fibers being uninvolved, whereas in other regions they are undergoing dissolution or hyaline degeneration. In the involved fibers the transverse striations and myofibrils have lost their characteristic appearance (Fig. 1).

*At 12 and 18 Hours.* There is a progression of the inflammatory reaction characterized by a more diffuse and intensive leucocytic infiltration, and a more diffuse and less patchy involvement of the muscle fibers. The edema is slightly increased. There is dilatation of the capillary bed. The leucocytic infiltration is prominent in the bands between the muscle bundles but there is little fat alteration. At 18 hours the mononuclear type of cell is noted to be

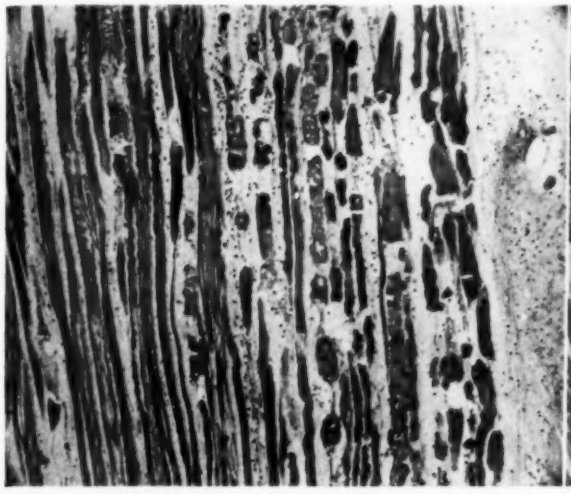

Fig. 1. Solution "B," 6 hours. Extensive edema with moderate leucocytic infiltration between muscle fibers, many of which are swollen, vacuolated and undergoing dissolution.

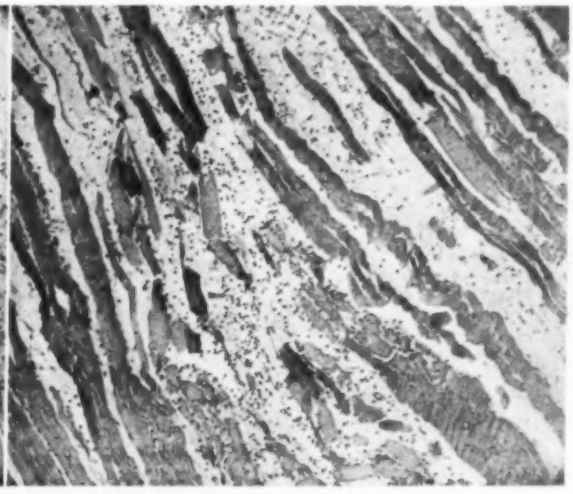

Fig. 2. Solution "B," 18 hours. Increase in leucocytic exudate with more extensive involvement of individual muscle fibers.

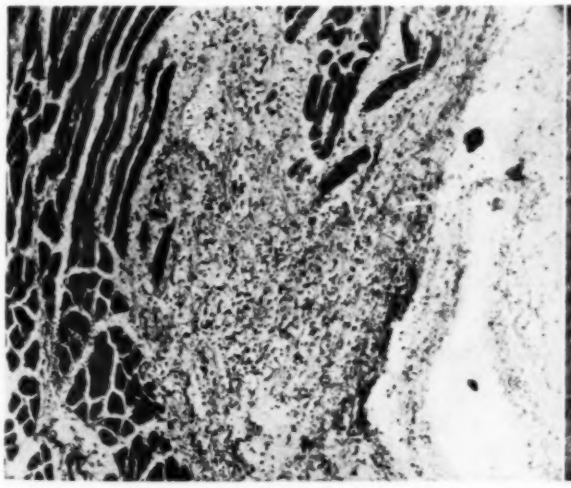

Fig. 3. Solution "B," 48 hours. Mononuclear and polymorphonuclear exudate replacing muscle fibers. Beginning organization of this exudate with development of spindle shaped cells and capillaries.

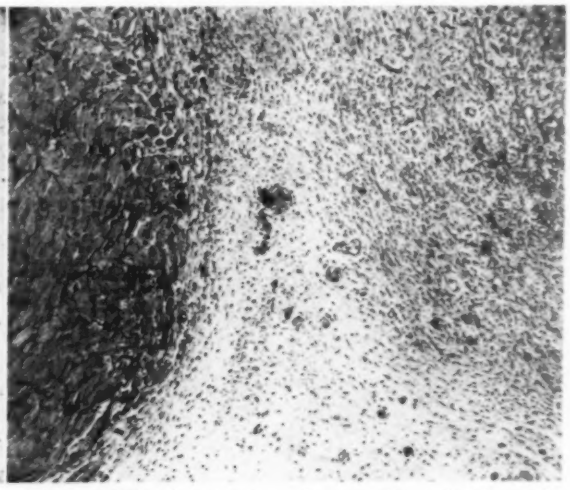

Fig. 4. Solution "B," 72 hours. Organization of leucocytic wall around muscle fibers. Definite proliferation of fibroblasts and capillaries, associated with many undifferentiated mononuclear cells.

increasing in numbers. Occasional muscle fibers take on a basophilic appearance (Fig. 2).

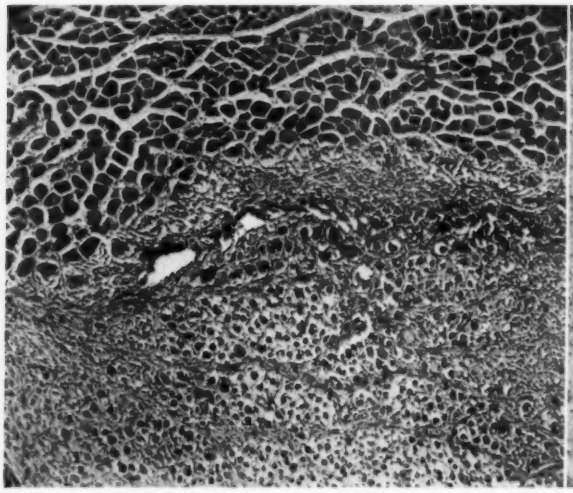

Fig. 5. Solution "B," 1 week. Demarcation of normal muscle by dense bands of fibrous tissue enclosing disintegrating muscle fibers.

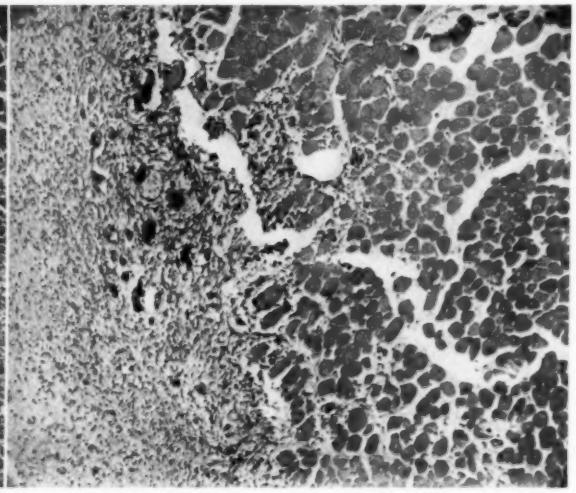

Fig. 6. Solution "B," 4 weeks. Large zone of necrotic muscle bounded by organized leucocytic wall. Phagocytosis of muscle fibers by giant cells.

*At 24 Hours.* There is a further progression of this type of reaction, with somewhat more involvement of the fat and interstitial fibrous tissue.

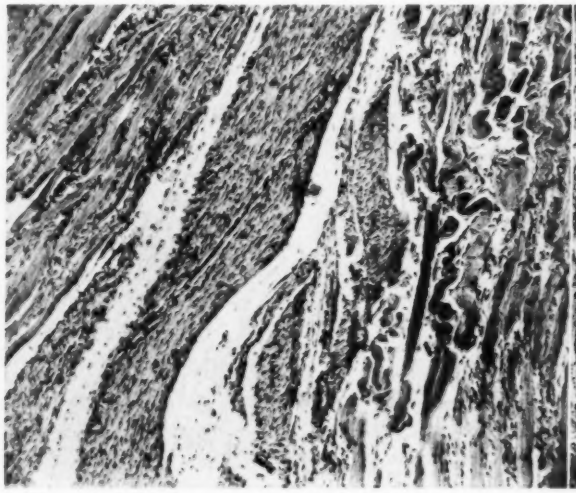

Fig. 7. Solution "B," 8 weeks. Dense band of fibrous tissue extending between muscle bundles, scattered mononuclear cells still remaining.

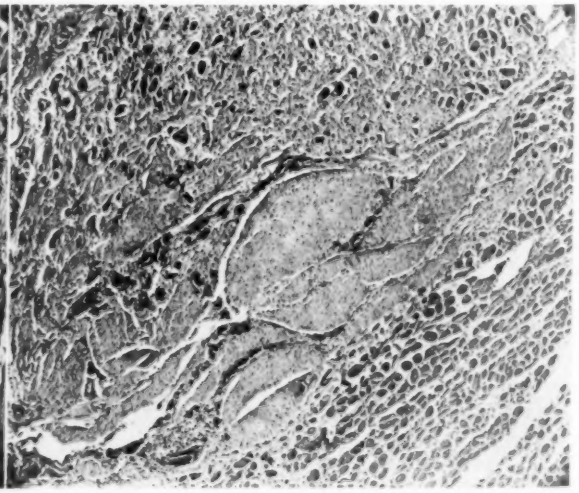

Fig. 8. Solution "B," 10 months. Thick bands of hyalinized fibrous tissue with extensions between adjacent muscle fibrils which is the end result of the inflammatory reaction.

*At 48 Hours.* A distinct zone of dead muscle is present, surrounded by a cellular exudate assuming the characteristic appearance of a leucocytic wall. There is a wide variety of large and small mononuclear cells present, and many of these cells in this wall are becoming spindle shaped. There is early capillary formation at the outer borders. A fine, pink staining collagenous material is also present. Occasional foreign body giant cells are present around the inner layer of this leucocytic wall (Fig. 3).

*At 72 Hours.* The leucocytic wall is becoming more distinct, with definite fibrous organization and capillary formation at the outer borders. The zone of

dead muscle is slowly undergoing dissolution, and the inner layer of the leucocytic wall contains many phagocytic mono-

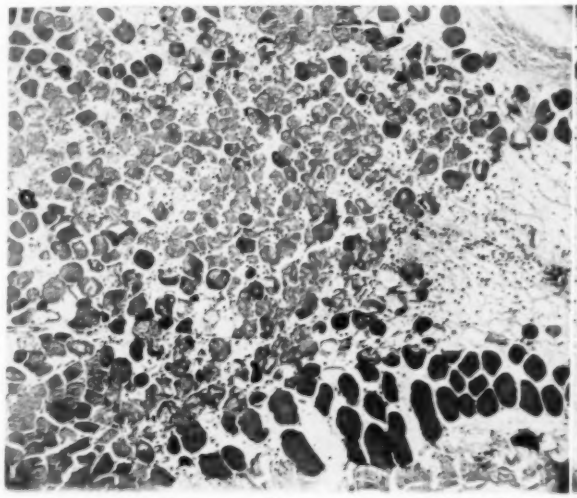

Fig. 9. Solution "C," 6 hours. Interstitial infiltration of polymorphonuclear leucocytes associated with edema and disintegration of muscle fibers.

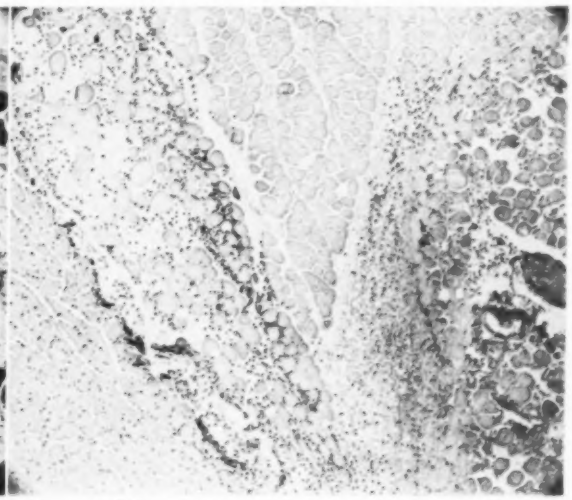

Fig. 10. Solution "C," 18 hours. Large area of dead muscle fibers surrounded by an early leucocytic exudate.

nuclear cells and foreign body giant cells. In one part of the leucocytic wall distinct fat necrosis is evident (Fig. 4).

*At 1 Week.* The marked edema seen previously is slowly disappearing. The leucocytic wall shows a much more extensive fibrosis at the outer borders. This newly formed fibrous tissue is becoming condensed into septal-like bands. The circumscribed region of dead muscle and fat is being removed, as described (Fig. 5).

*At 2 Weeks.* The region of dead muscle is being removed slowly and is surrounded by compact bands of fibrous tissue. These fibrous tissue bands send out fine branches between the individual muscle bundles for a considerable distance. Occasional small foci of polymorphonuclear leucocytes, lymphocytes and phagocytic cells are present in the older portion of the fibrous tissue. There are also phagocytic cells holding hemosiderin. The muscle adjacent to this region is compactly arranged, with no alteration of the finer cytoplasmic details, and there is an increase in the number of sarcolema neuclei.

*At 4 Weeks.* There is still a large circumscribed region of muscle undergoing dissolution and removal. The leucocytic wall has increased in thickness. At its outer borders collagen formation is becoming increasingly more extensive. At the inner zone the usual inflammatory cells, including giant cells, are present (Fig. 6).

*At 8 Weeks.* This picture is not extensively altered. There is noted, however, a thin border of granular basophilic material at the inner layer of the fibrous wall. There is an extensive increase in fibroblastic proliferation (Fig. 7).

*At 10 Months.* The region of dead muscle and the leucocytic wall have disappeared and in its place there remains a thick, irregular hyalinized band of fibrous tissue. The muscle bundles on both sides of this fibrous tissue are normal. Occasional thin bands of old fibrous tissue enclose a few fibrils. Associated with the fibrous tissue are a few scattered foci of lymphocytes (Fig. 8).

### Results with Solution "C"

*At 6 Hours.* The reaction is one of extensive edema, marked diffuse leucocytic infiltration, and alteration of the muscle fibers. These changes are hyaline degeneration or vacuolization of the individual muscle fibrils. There is a marked accumulation of the leucocytes in the interstitial

tissue, with the alteration of the fat of these regions (Fig. 9).

*At 12 Hours.* There is an increase in all these changes, particularly in the fat reaction.

*At 18 Hours.* There is a definite, almost circumscribed region of dead muscle which is extremely edematous and in some regions appears to be delimited by accumulations of leucocytes. The other reactions show progression (Fig. 10).

*At 24 Hours.* This leucocytic wall is somewhat more sharply defined, and many of the components are mononuclear cells. At the outer portion these mononuclear cells take on spindle shapes and are differentiating to form either fibroblasts or endothelial cells.

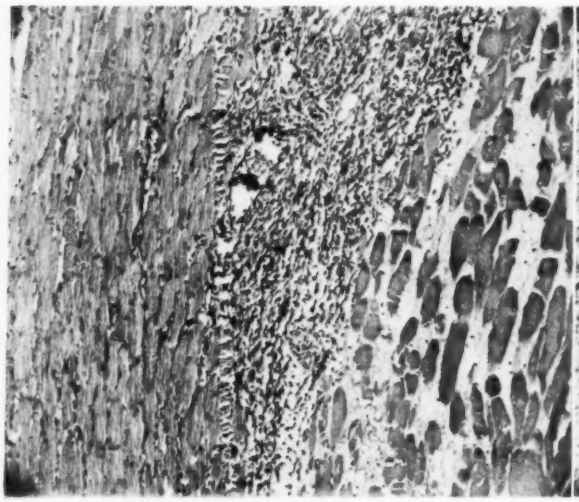

FIG. 11. Solution "C," 48 hours. Area of dead muscle fibers surrounded by proliferating spindle shaped cells and leucocytes.

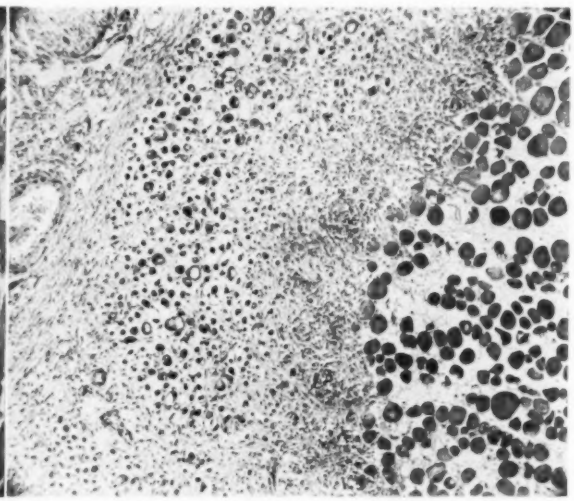

FIG. 12. Solution "C," 72 hours. Organization of leucocytic wall with formation of collagenous tissue and capillary, surrounding zone of dead muscle fibers.

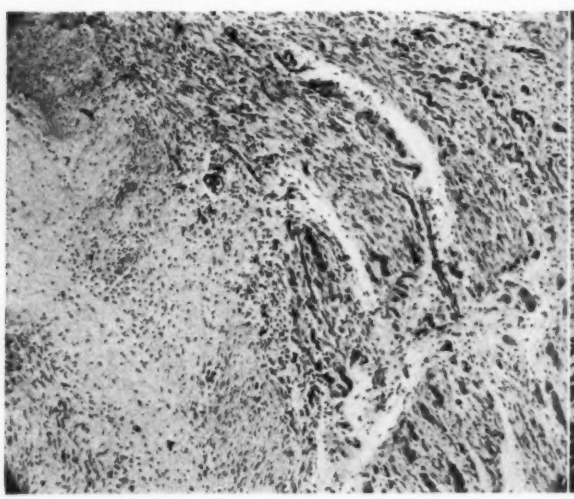

FIG. 13. Solution "C," 1 week. Outer portion of leucocytic wall, showing extensive fibrous proliferation and perivascular accumulations of mononuclear cells.

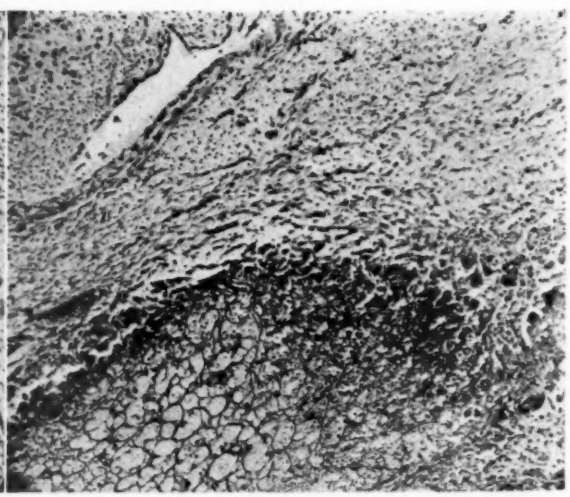

FIG. 14. Solution "C," 4 weeks. Inner portion of fibrous wall showing area of fat necrosis in the remaining necrotic material.

*At 48 Hours.* This circumscribed zone of dead muscle now stands out sharply and the leucocytic wall surrounding it shows fibroblastic proliferation and capillary forma-

tion. Giant cells are numerous, associated with mononuclear and polymorphonuclear cells at the inner zone of this wall. Where there had been fat, there is a fairly typical fat necrosis. Many of the muscle fibrils are surrounded by giant cells (Fig. 11).

A study of the solutions at 72 hours, 1, 2, 4 and 8 weeks, and 10 months reveals no significant changes from that described as occurring in solution "B" at the same periods (Figs. 12, 13, 14, 15). After careful study of these solutions it is impossible to distinguish the reactions illicited by these solutions. The degree of fibrosis and the intensity of the inflammatory reaction is the same with either solution.

A summary then of the microscopic reaction of both of these solutions, and likewise solution "A" which has been previously reported, is as follows: The reaction is first characterized by edema, polymorphonuclear leucocytic infiltration and alteration of muscle fibers. In the course of twenty-four hours there is definite progression of these processes, with the beginning influx and proliferation of mononuclear elements. These differentiate to form fibroblasts and phagocytic cells.

At the end of 72 hours a definite circumscribed zone of muscle has undergone degeneration and is delimited from the uninvolved parts by accumulations of leucocytes, proliferating fibroblasts and capillaries. Evidences of fat alteration are present in all, but somewhat more prominent with solution "C." From this period on the reaction is similar in all, and there is a diminution in the number of inflammatory cells, together with an increased proliferation of fibroblasts. The fibroblasts show condensation and collagen formation and tend to arrange themselves as thick bands. The dead muscle is entirely removed at the end of ten months. By this time the only evidences of previous inflammation are thick hyaline bands of fibrous tissue permeating between the muscle bundles. The end result of the inflammatory process produced by the three solutions is identical.

### PERITONEAL TOXICITY

Injections of varying amounts of these solutions were made into the peritoneal

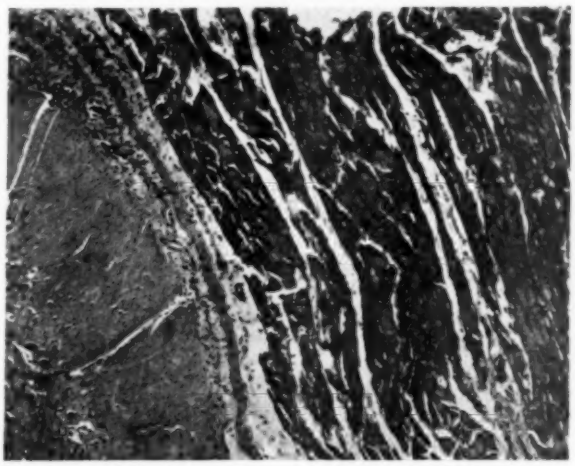

Fig. 15. Solution "C," 10 months. Scar tissue remaining between muscle fibers.

cavities of normal guinea-pigs in an attempt to determine their toxicity. Dosages were given relatively much greater than those which would be used in human subjects. Injections of 0.5, 1, 2 and 3 c.c. were administered and examinations made 6, 24, 72 hours and 7 days following. Macroscopically, examination in all the animals was entirely negative. Sections of the bowel, liver, spleen, lymph nodes and parietal peritoneum were entirely negative except for a slight swelling of the mesothelial cells lining the peritoneum.

However, in a substantial number of animals the injection of 2 c.c. of solution "A," 2 c.c. of solution "B," or 3 c.c. of solution "C" resulted in shock and death of the animals injected within a period of five to thirty minutes. Of 24 guinea-pigs so injected, 12 died in this fashion. The remainder, however, when autopsied showed no difference in microscopic findings from those animals injected with smaller doses (Table 1).

To summarize, then, all three solutions are relatively nontoxic when injected peritoneally. In large doses, however, shock and death occur. Solution "C" is somewhat less toxic in this regard than solutions "A"

TABLE I

RESULTS OF INTRAPERITONEAL INFECTION OF SOLUTIONS "A," "B" AND "C" IN NORMAL GUINEA-PIGS

| Type of Solution | Amount of Solution, C.c. | 6 Hours | 24 Hours | 72 Hours | 7 Days |
|---|---|---|---|---|---|
| A | ½ | Negative | Negative | Negative | Negative |
| | 1 | Negative | Negative | Negative | Negative |
| | 2 | Died | Died | Negative | Negative |
| | 3 | Died | Died | Died | Negative |
| B | ½ | Negative | Negative | Negative | Negative |
| | 1 | Negative | Negative | Negative | Negative |
| | 2 | Died | Died | Died | Negative |
| | 3 | Died | Died | Negative | Negative |
| C | ½ | Negative | Negative | Negative | Negative |
| | 1 | Negative | Negative | Negative | Negative |
| | 2 | Negative | Negative | Negative | Negative |
| | 3 | Died | Died | Negative | Negative |

and "B." As a further check on the toxicity of these solutions an investigation of their hemolytic activity was undertaken. Varying amounts of the solutions were mixed with a 2 per cent suspension of washed human red blood cells and with whole defibrinated human blood. Likewise, tests for the formation of precipitate in the presence of human serum were made. Tables II, III and IV summarize these results.

TABLE II

HEMOLYTIC ACTIVITY OF SOLUTIONS "A," "B" AND "C" USING 2 PER CENT SUSPENSION OF WASHED HUMAN RED BLOOD CELLS; 1 C.C. OF RED BLOOD CELL SUSPENSION WAS ADDED TO 1 C.C. OF DRUG DILUTION AND INCUBATED FOR ONE HOUR AT 37 DEGREES C. IN A WATER BATH

| Final Dilution of Drug | Solution "A" | Solution "B" | Solution "C" |
|---|---|---|---|
| 1:2 | Brown precipitate No hemolysis | Brown precipitate No hemolysis | Complete hemolysis Clear brown color |
| 1:10 | Hemolysis ++ Red brown precipitate | Hemolysis + Red brown precipitate | Complete hemolysis Clear red brown color |
| 1:100 | None | None | Complete hemolysis |
| 1:1000 | None | None | Complete hemolysis |
| 1:10000 | None | None | None |

## STERILITY OF SOLUTIONS

Each of the solutions was cultured aerobically and anaerobically and was found to be sterile. Acknowledgment is due Dr. Charles Weiss for his supervision of this work.

TABLE III

HEMOLYTIC ACTIVITY OF SOLUTIONS "A," "B" AND "C" USING WHOLE DEFIBRINATED HUMAN BLOOD; 0.05 C.C. OF WHOLE DEFIBRINED HUMAN BLOOD WAS ADDED TO 1 C.C. OF DRUG DILUTION AND INCUBATED IN THE WATER BATH FOR ONE HOUR AT 37 DEGREES C.

| Final Dilution of Drug | Solution "A" | Solution "B" | Solution "C" |
|---|---|---|---|
| Undiluted | Brown precipitate No hemolysis | Brown precipitate No hemolysis | Complete Clear brown color |
| 1:10 | Hemolysis + Brown precipitate | Complete | Complete Reddish brown color |
| 1:100 | None | Hemolysis ++ Milky appearance | Complete |
| 1:1000 | None | None | None |
| 1:10000 | None | None | None |

TABLE IV

FORMATION OF A PRECIPITATE IN THE PRESENCE OF HUMAN SERUM BY SOLUTIONS "A," "B" AND "C"; 0.15 C.C. OF HUMAN SERUM WAS OVERLAID BY AN EQUAL AMOUNT OF DRUG DILUTIONS AND INCUBATED FOR ONE HOUR AT 37 DEGREES C. IN THE WATER BATH

| Drug Dilution | Solution "A" | Solution "B" | Solution "C" |
|---|---|---|---|
| Undiluted | ++++ | ++++ | +++ |
| 1:10 | plus-minus | plus-minus | + |
| 1:100 | None | None | None |
| 1:1000 | None | None | None |
| 1:10000 | None | None | None |

## CLINICAL EVALUATION

Our clinical experience with these solutions has been described elsewhere.* However, it may be stated at this time that all three solutions are satisfactory when used on patients. The results with patients as well as the experimental findings show no advantage of one solution over the others.

* HARRIS, F. I. and WHITE, A. S. The injection treatment of hernia: its experimental basis. *Calif. and Western Med.*, 45: 382–385 (Nov.) 1936; The injection treatment of hernia: its present-day status. *Calif. and Western Med.*, 45: 391–395 (Nov.) 1936.

## SUMMARY AND CONCLUSIONS

Three solutions used in the injection treatment of hernia have been evaluated from the clinical and experimental standpoints. They are proved to produce fibrous tissue in experimental animals, to be relatively non-toxic when injected into the peritoneal cavities of experimental animals, and to be sterile.

1. The criteria for satisfactory solutions to be used in the injection treatment of hernia are:
   a. The ability to produce fibrous tissue when injected into the muscles of experimental animals;
   b. Non-toxicity when injected into the peritoneal cavities of experimental animals;
   c. Sterility;
   d. Satisfactory results when used on patients.
2. The experimental results of injection of two such solutions in the thigh muscles of guinea-pigs are reported in detail.
3. The results of intraperitoneal injection into normal guinea-pigs of three such solutions are described.
4. The results of bacteriological tests for sterility of these solutions are presented.
5. Solutions "A," "B" and "C," which have been used in a series of 225 cases of hernia, have been proved to fulfill the four criteria proposed as necessary for satisfactory solutions which may used in the injection treatment of hernia.
6. It is imperative that solutions used for the injection treatment of hernia be carefully and accurately investigated before being used on patients. The indiscriminate use of unproved solutions will result in dangerous complications.

# A NEW SCLEROSING DRUG FOR VARICOSE VEINS—MONOLATE

S. THOMAS GLASSER, M.D., C.M.

Instructor in Surgery, Flower-Fifth Ave. Hospital; Chief of Surgical and Vascular Clinic, Metropolitan Hospital

NEW YORK CITY

THE experimental use of monolate in our vascular clinic has proved efficacious, and we have given 550 injections without untoward reactions. Monolate consists of monoethanolamine oleate 5 per cent, with benzyl alcohol, and is closely allied in composition and action to sodium morrhuate.

The popularity of sodium morrhuate has been well deserved, the only criticisms being directed against the occasional allergic reactions and the lack of standardization of this chemical. The exact chemical composition of the morrhuate solution is probably never the same in two separate ampoules, because of its derivation from cod liver oil which in itself varies in composition, depending upon the source of supply and other allied conditions. Therefore, a synthetic oleate with a definite composition, whose therapeutic action equals that of sodium morrhuate, is desirable. The synthetic drug, lacking impurities, obviates allergic reactions and allows for a better comparison of clinical results.

In our cases monolate has proved as effective as sodium morrhuate. There has been no instance of slough following inadvertent perivenous injection. Muscle cramps have not occurred nor have allergic manifestations been noticed. The results observed six months later have been satisfactory.

## SUMMARY

In view of the absence of side-effects and the desirability of a "morrhuate-like" drug, monolate has filled the necessary requirements and should be added to the list of desirable chemicals in vogue for the injection treatment of varicose veins.

# CASE REPORTS

## OSTEOGENIC SARCOMA FROM EXOSTOSIS

E. A. FENNEL, M.D., F.A.S.C.P.

Director, Department Clinical Pathology, The Clinic; Pathologist to Leahi Home, and Kauikeolani Children's Hospital

HONOLULU, HAWAII

IT is generally conceded, by surgeons and radiologists alike, that the prognosis in typical osteogenic sarcoma is about as hopeless as in melanotic sarcoma. However, in 1925, E. A. Codman suggested, in a personal communication to me, that osteogenic sarcoma originating in a pre-existing exostosis, might have a more favorable prognosis. He was led to that suggestion by a case he had had under observation a long time—more than ten years in 1925—in which an exostosis on the humerus took on active growth and the arm was amputated. Ten years later an exostosis on the femur became malignant and amputation of the thigh was done. In 1925 that patient had survived his first operation fifteen years. This case was filed with the Bone Sarcoma Registry under No. 343 but its interest is detracted from by the varying opinions of the reviewing pathologists, who classified it as "Recurring infiltrating myxochondroma, myxo-fibro-chondroma, chondrosarcoma, osteogenic sarcoma, borderline tumor," and one pathologist marked it "not a malignant tumor."

In the following case there is more unanimity of opinion in the minds of the pathologists who reviewed it when the case was filed with the Sarcoma Registry, under No. 668, in 1925. This patient has now survived his first symptoms thirteen years, and because there are some interesting, instructive features, it is thought worthy of recording.

At the time of filing the case with the Registry, the following history and very many illustrations, some herewith reproduced, were submitted:

### "THE CASE OF HONG MUN, COLLOQUIALLY KNOWN AS KNOBBY WILLY, THE EXOSTOTIC KID"

Male Korean, age 45, widower, of Waimanalo Plantation, Hawaii, Queen's Hospital Case 21925.

He presented himself February 1923, complaining of swelling about the right knee, of about three months standing. He gave a definite history of injury, having fallen from a roof and struck his right knee apparently subjecting a pre-existing exostosis of that region, to trauma. Some three weeks later he noticed enlargement about the right knee, which became rapidly and progressively larger, until three months later he presented himself because the tumor mass interfered with locomotion and pursuit of his occupation, that of a carpenter.

On examination the tumor mass was found to be quite firm, no fluctuation nor pulsation, and extended from the upper end of the tibia to more than midway up the thigh, chiefly on the anterior and inner aspects. The continuity of the skin was nowhere interrupted. Large subcutaneous veins were prominent. There was no pain nor tenderness on palpation. Only a slight degree of active or passive motion was permitted by the size of the tumor. In general shape it was fusiform, but no limitations of the mass could be determined, since it shaded off into the adjacent musculature. No involvement of the inguinal lymph nodes could be discovered.

In addition to this tumor of the right knee, this man exhibited multiple exostoses, particularly on the left leg, involving tibia, fibula

and femur. Exostoses on the right arm and forearm were noticeable, while both arms seemed to be bowed and considerably shorter than normal, suggesting somewhat the cretan type. He said that these exostoses had been present from his earliest recollection and that he had noted the occurrence of no new ones in his later years. Language difficulties prevented the elicitation of a clear family history.*

Roentgenographs showed a tumor involving the femur area only. The femur shadow showed two areas of rarifaction above the condyles, with denser edges, a well demarcated exostosis above the outer condyle and the remanants of an exostosis—that looked as though it had exploded—above the inner condyle and pointing directly into the tumor mass. The periosteal bone seemed interrupted at this point. In the tumor mass were six or more calcific masses, more or less round, more dense in their centers. Roentgenographs of the arms, forearms and hands as well as the other femur showed the presence and character of these multiple exostoses.

Fig. 1. Right leg, original condition, Feb. 7, 1923. Note prominent veins in tumor mass. Note exostosis on right tibia as well as on femur and tibia of left leg.

Fig. 2. Feb. 7, 1923. *X*-ray of original condition. Note "exploded" condition of exostosis on inner aspect of femur and the denser masses (calcium) within the tumor mass. Exostoses on outer aspect of femur and on tibia and fibula.

A pre-operative diagnosis of sarcoma, osteogenic, periosteal, was made; sarcoma because of its rapid growth, osteogenic because of its apparent capacity for calcific deposit and periosteal because of its anatomic position as well as its seeming origin in the periosteum at or near the pre-existing exostosis.

Amputation was advised but emphatically refused by the patient. Operation only was permitted and with some misgivings Dr. J. E. Strode, assisted by Dr. Milnor, on Feb. 9, 1923, with ether anesthesia, removed as much of the tumor mass as was possible. The only place in which the tumor was well demarcated was at its upper pole, where there seemed to be remnants of a capsule; in all other places it infiltrated the muscles. It was rather soft, meaty, highly vascular material, and the large, irregular mass—some three or four pounds of it—was removed with difficulty and with some

* It was subsequently determined that he did not remember his grandfather, but that his father had two exostoses on his legs; and that the patient has only one child, a daughter, without exostoses.

shock to the patient. It involved the bone nowhere except at the site of the pre-existing exostosis where the periosteum was absent and erosion of bone present. Before closure two 50 mgm. tubes of radium (filtered through 0.5 mm. silver, 2 mm. brass and 3 mm. rubber) were inserted, rather superficially, but placed to cross-fire the eroded area of bone. These were allowed to remain in place for twenty-four hours.

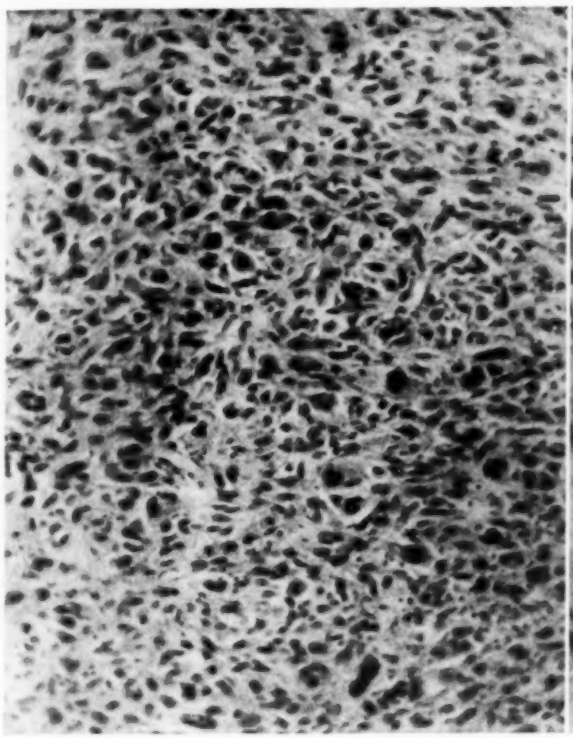

Fig. 3. Low power photomicrograph to show the architecture of the specimen, the marked variation in size of cells, the sparse stroma and mitoses.

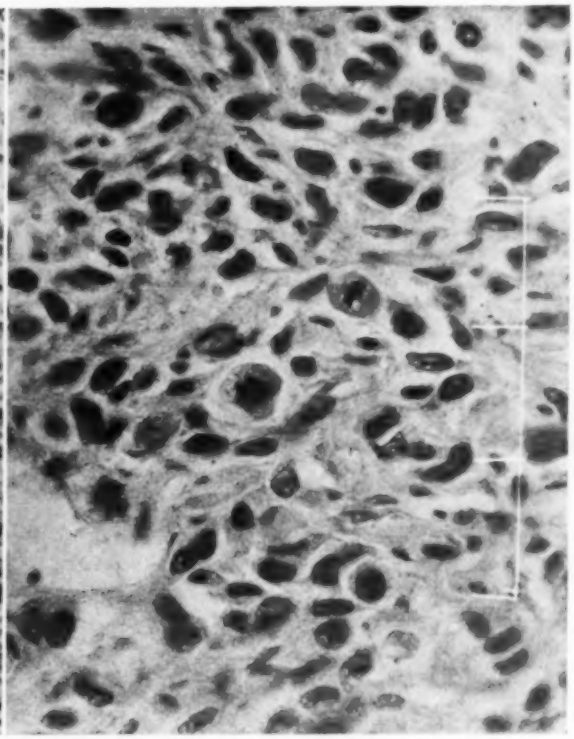

Fig. 4. High power photomicrograph showing character of osteogenic cells, with atypical mitoses. Each division of the scale indicates 50 micra.

On gross section, the mass was rather homogeneous, except for occasional bits of calcareous material, small spicules of bone. The post-operative diagnosis continued as periosteal osteogenic sarcoma, and the prognosis, so it was agreed upon by at least twenty-five visiting physicians, was fatal.

The histo-pathologic sections showed the tumor to be highly cellular and very vascular. Many areas of necrosis and degeneration were noted. Some areas were so vascular as to be almost telangiectatic or angiomatous while in other areas the blood vessels were not so marked. What little stroma was present consisted of a very fine fibrous tissue network; no hyaline nor cartilaginous matrix was found in any of the sections. The intrinsic cells were highly unripe, very embryonal, in type, with tremendous variation from very small ones, with small, compact nuclei to huge ones with one or two (sometimes more) large nuclei with loosely woven chromatin fibrils. Typical giant cells were not prominent. These tumor cells were looked upon as the progenitors of osteoblasts or osteoclasts and this conviction was strengthened by their capacity for bone formation. While mitotic figures were abundant, they were not so numerous as the rapid growth of the tumor led one to expect. It is to be regretted that none of the sections were made from the calcific areas of the tumor. Histologic Diagnosis: Osteogenic periosteal or parosteal sarcoma, malignant.

The patient rallied from the operation, had a moderate fever for a while, drained considerably from the wound, though there was no infection and on the tenth day, with splint applied, was up in a wheel chair.

On February 27, 1923, (on the eighteenth day) he was well enough to stand on the affected leg and come to the office for photographs and roentgenograms. At that time there

were no evidences of metastases anywhere, a chest examination revealing nothing abnormal. He returned to the plantation.

FIG. 5. July, 1924, one and a half years after operation. The cortex remains eroded, with thickening at the edge.

By June 12, 1923 (123 days after operation) a small radium burn had developed. This was curetted and dressed for several weeks. He was at this time again actively at work. The roentgenograms showed some erosion of bone. He had no symptoms of any kind, found his right leg quite useful and followed regularly his occupation.

He then disappeared from observation until July 22, 1924, when one of us met him on his way to work. The roentgenograph, nearly one and a half years after operation, still showed the large eroded area of the cortex of the femur, the site of the former exostosis, with some thickening of the margins. At that time he had no objective nor subjective symptoms. Since then we have seen him, accidentally, from time to time and, as far as we know, he continues in good health at this time, two and a half years after operation.

*Summary:* A rapidly progressive tumor of the lower end of the femur, developing from a pre-existing exostosis, was operated upon by sharp dissection. The clinical and histological diagnosis was osteogenic periosteal sarcoma. No recurrence nor metastases two and a half years after operation.

The accurate classification of this neoplasm within the eight divisions of the Sarcoma Registry offers some difficulty. It might be classed as a periosteal fibrosarcoma because of its origin, its anatomical location, its failure to invade bone and its lack of metastases, even under the trauma of operation. But this tumor was definitely osteoblastic (actually producing bone) which fact pushes it to the border or over the border into the group of osteogenic sarcoma. It seems to answer the requirements of this group quite well but should more properly be placed under the subhead of undifferentiated sarcoma. But the favorable outcome, in the face of the histologic picture, even though 2400 mgm. hours were employed, makes one hesitate to locate it in this group. It does not seem plausible that two fifty mgm. tubes of radium, located necessarily so far from the outpost cells that must have been missed in the operation (even though these cells were extremely embryonal and therefore most highly susceptible to irradiation) could have so favorably influenced an otherwise highly malignant neoplasm.

Further study of this group of osteogenic sarcoma may create several definite subheads, with clear roentgenological, clinical and histologic pictures that will accommodate, in every particular, the case submitted.

The pathologists who reviewed the case agreed on the diagnosis of osteogenic sarcoma.

E. A. Codman said, "This case is similar to that of No. 343 (Wm. E. Smith, reported by Massachusetts General Hospital). This

patient also had multiple congenital exostoses; one on the arm became malignant and was amputated. Ten years later one on

Fig. 6. May, 1936, more than thirteen years after operation.

the femur became malignant and the femur was amputated. Neither tumor was as malignant histologically as the tumor in this case, No. 668, which is a typical osteogenic sarcoma. However, the freedom from recurrence of two and a half years in this case and of ten or more years in No. 343, suggests that a better prognosis may be given in these cases arising in multiple tumors than in those which arise in normal individuals."

F. B. Malloy said, "Osteogenic sarcoma."

C. L. Connor said, "Osteogenic sarcoma."

J. Ewing permitted himself to become facetious but his little witticism has been one of my most prized rewards in twenty-eight years of the study of medicine, for praise from Caesar is praise indeed. He said, "Osteogenic sarcoma. Large polyhedral cells of cartilaginous derivation. Important case, extremely well reported. Dr. Fennel should be put on the staff of the Massachusetts General Hospital at once and a statue erected to the Exostotic Kid in the yard, to teach conservative surgery on bone sarcoma."

This patient subsequently secured occupation as carpenter in a Sanatorium to which I act as visiting Pathologist, and there I have had opportunity to observe him weekly. He has had some minor illnesses, and once developed an anemia from undiscoverable cause. The resident physician suspected neoplastic involvement of bone marrow, and took numerous X-rays, including a gastro-intestinal series, but no new abnormalities were found. His hemoglobin and red cells soon returned to normal. In 1928 he developed symptoms of ureterolithiasis and was operated upon. Through a Mayo incision a moderate hydronephrosis with an impacted stone one inch below the pelvis was found. The stone was removed and convalescence was uneventful.

At the present time, more than thirteen years after his operation, he continues in a normal state of health, and no other of his

many exostoses has taken on malignant activity.

Codman's suggestion is repeated; is there something about the growth capacity of an osteogenic sarcoma originating in an exostosis that makes the prognosis more hopeful than usual, and should our predictions therefore, be more non-committal?

Many surgeons and pathologists hold that trauma to a neoplasm, even the slight trauma of a careful biopsy, is attended by the danger of liberating tumor cells into the lymph or blood streams. Yet here is a tumor of highly malignant appearing cells, highly vascular and infiltrating adjacent muscle, very severely traumatized by an extensive sharp dissection—almost a débridement—and no metastases followed.

Some radiologists maintain that small doses of irradiation stimulate neoplastic cells to increased activity and growth. Yet in this case, it would be impossible to imagine, from the very nature of the infiltrating tumor, that all neoplastic cells had been surgically removed. It is much easier to visualize those outpost cells that had been surgically missed as being irritated and stimulated by the obviously inadequate radium dosage of 2400 mgm. hours in one small localized area. And yet, for some unknown reason, this sarcoma did not recur locally nor at the outpost areas.

I should like to give credit for his recovery to the Hawaiian climate but that, probably, is going a bit too far, even for a Honolunatic.

## SUMMARY

The case reported is that of an adult male, with multiple congenital (familial) exostoses. One of these on the lower portion of the femur was subjected to violent trauma. In three weeks enlargement was noticed; in three months the size of the tumor was interfered with locomotion. Amputation was refused. A massive sharp dissection was performed and 100 mgm. radium was implanted for twenty-four hours. The histologic sections showed osteogenic sarcoma, so diagnosed by all the consultants of the Bone Sarcoma Registry. Thirteen years after operation the patient is alive and well. It is suggested that osteogenic sarcoma arising in an exostosis has a better prognosis than the usual kind.

# ACUTE TORSION OF PEDUNCULATED LIPOMA OF KNEE-JOINT*

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FISHER, in his excellent treatise on Internal Derangements of the Knee-Joint published in 1924, states that loose bodies composed of occasional tissue other than bone or cartilage may arise from: (a) hypertrophied synovial fringes; (b) lipomata: single, multiple, or diffuse; (c) other causes, such as angeioma, sarcoma, and secondary carcinoma. He also states that enlargement of various fatty processes may give rise to symptoms of internal derangements and that all the members of this group, with the possible exception of angeiomata, may become quite free in the joint.

The following case report is that of a pedunculated lipoma which became twisted on its pedicle to such an extent that it interfered with the circulation of the lipoma and resulted in necrosis of a good portion of its body. Furthermore, the lipoma acted as a loose body and also gave rise to symptoms suggestive of those resulting from loose body formation.

## CASE REPORT

B. O'C., female, aged 47, a lady's maid by occupation, was admitted to the New York Hospital April 28, 1936, complaining of pain and swelling of the right knee of approximately two weeks duration. She gave a history of indefinite injury involving the affected part and stated that for the preceding seven days prior to admission she was practically incapacitated. At about that time her knee suddenly became enlarged and painful and there was marked pain and tenderness about the outer aspect of the knee and attempts at extension of the joint caused extreme pain. There was no history of a previous disturbance of a similar nature.

*Examination:* The routine examination was essentially negative except for evidences of osteoarthritis of a mild form involving the larger joints of the body.

Local examination: The patient was observed lying in bed with the right knee flexed approximately 15 degrees. The joint on measurement was enlarged one-half inch in circumference as compared with its fellow. The knee could be extended only to 165 degrees and flexed for 75 degrees, and both movements were accompanied by pain, more particularly extension. There was no local heat present. The joint contained free fluid. There was extreme tenderness over a localized area about the size of a twenty-five cent piece immediately anterior to the external lateral ligament.

Roentgen ray examination of both knee-joints disclosed evidences of osteoarthritis (sharpness of outline of condyles of both tibia and femur).

The knee-joint was subsequently aspirated, and several days following aspiration further examination disclosed the presence of an ovoid loose body situated in the lateral compartment of the joint and immediately anterior to the external lateral ligament. This formation was about the size of a large lima bean and could be moved about through a range of approximately three-eighths of an inch. During flexion of the joint the mass would disappear only to reappear on extension. It was extremely tender to touch. The *x*-rays were thereupon again examined anticipating that a loose body had been overlooked. No such formation could be observed and it was therefore deemed advisable to subject the patient to operation.

The operative procedure was carried out under gas oxygen anesthesia and the right knee was entered through a linear incision over its lateral aspect. Upon entering the synovial cavity a large amount of slightly chocolate colored, thickened synovial fluid exuded. The synovial tissue was observed to be somewhat thickened and congested. A pedunculated congested lipoma was delivered into the wound. The mass was covered with a fine

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layer of fibrin at its base. The pedicle was short, twisted on itself, markedly congested, and attached to the lateral portion of the fat pad.

FIG. 1. Photograph of specimen. "A" denotes pedicle.

This formation was then excised and further exploration of the joint revealed pathology indicative of osteoarthritis, but not sufficient to require surgical intervention. The wound was closed in the usual manner using silk throughout, and a plaster of Paris bandage was applied from the toes to the groin.

The post-operative course was unremarkable, motion being encouraged under traction after the first few days of immobilization, physiotherapy was instituted and the patient subsequently fitted with an elastic knee corset containing metal hinged side bars. She was discharged from the hospital on the twenty-first post-operative day after an entirely afebrile course, and was able to get about with the aid of a cane.

*Laboratory report:* "The specimen consists of a flat mass of light yellow-brown tissue resembling a tongue-like projection and severed at its base. It measures 3.5 cm. from apex to base and 2.5 cm. in its widest point. It is shaped like an Indian arrow-head. It is covered with a very delicate fibrous membrane which is tough and difficult to cut. On section it is hemogenous and soft resembling altered fat. The section consists largely of dense fibrous tissue with necrosis in its center and numerous giant cells. No tubercles are found. The picture is that of slow death of tissue. There is considerable pigment, probably hemosiderin, scattered in the sections. No definite synovial covering found."

This represents an unusual instance of internal derangement of the knee-joint, and as such is here recorded.

## SUMMARY

Pedunculated lipoma of the knee-joint is uncommon, and more particularly uncommon is the fact that such lipoma may become acutely twisted, causing symptoms such as pain, limitation of motion and locking, acting as if it were a loose body or a split semilunar cartilage.

The case report recorded is an instance of such a condition, having occurred in a female, aged 47, who presented a history of

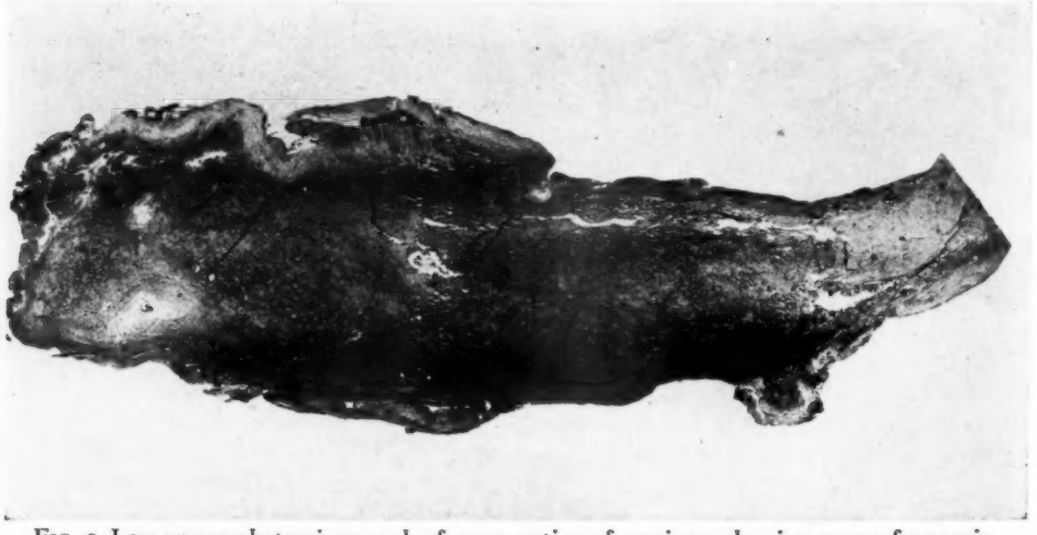

FIG. 2. Low power photomicrograph of cross section of specimen showing areas of necrosis.

a rather indefinite injury suffered several days prior to admission. Examination at the time of admission to the hospital disclosed swelling, limitation of motion, and inability to completely extend the joint. At the time of operation a pedunculated lipoma, markedly congested and discolored, was observed to be the sole cause of the patient's symptoms. The mass was removed and the patient made an uneventful recovery.

REFERENCE

1. Fisher, A. G. T. Internal Derangements of the Knee-Joint, Macmillan, 1924.

"It is of interest to note that when Hodgkin's glands take on sarcomatous infiltrating growth it is the endothelioid cells which produce the invading cells. Never in my experience has there been such as invasion by the lymphocytes in Hodgkin's disease."

"Though congenital, these tumors [dermoid cysts] usually are not observed until early adult life or beyond. The dermoids are found in situations where lipomas are generally found. They are usually observed in the midline, beneath the chin, and in the region of the mastoid process."
From—"Surgical Pathology of the Diseases of the Neck," by Arthur E. Hertzler (Lippincott).

# FRACTURE OF THE PROXIMAL PHALANX OF THE THUMB

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THE efficiency of a hand with the thumb impaired is lessened as much as 50 per cent, since the thumb is the opposing member to the fingers. The treatment for fractures of the phalanges is given in a general way in textbooks, but no attempt is made to differentiate between the various bones comprising the phalanges. A deformed proximal phalanx of the thumb would probably hamper a worker greatly and the conditions met with in a fracture of this bone are different from any other of the phalanges.

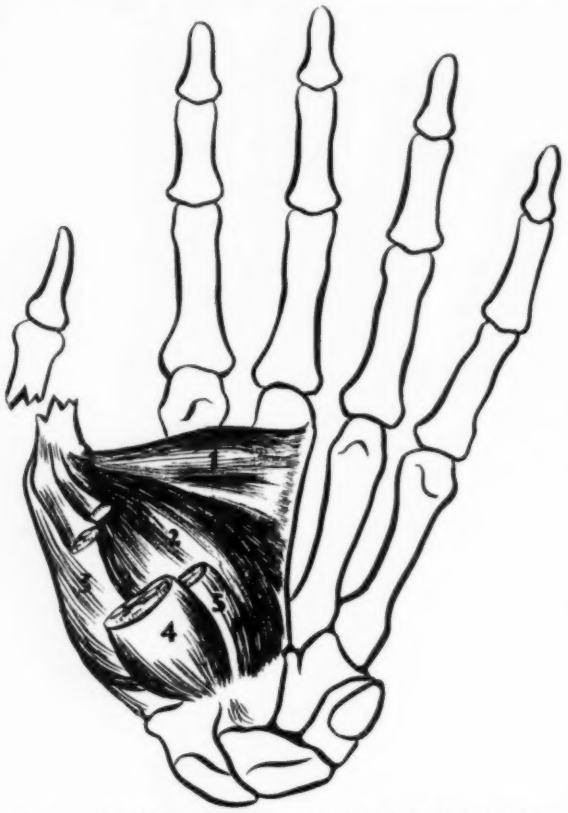


FIG. 1. (1) Ad. Pol. Trans. (2) Ad. Pol. Obl. (3) Opp. Pol. (4) Abd. Pol. Brev. (5) Fl. Pol. Brev. Muscle spasm causing deformity.

It is a recognized principle in the treatment of fractures that when the proximal fragment tends to be drawn in a given direction because of the muscle spasm excited by the injury, the axis in which the bones are immobilized is tilted in that direction. The transverse and oblique adductors of the thumb insert at the base of the proximal phalanx, and exert a strong pull on that bone. Some of the muscles of the thenar eminence cause flexion which accentuates the effect of the adductors. The remaining muscles abduct the thumb, acting in a plane perpendicular to the plane of action of the adductors and flexors. After a fracture of the proximal phalanx of the thumb, muscle spasm about the metacarpophalangeal joint of that digit causes the proximal fragment to be adducted toward the palm of the hand, and the lesser action of the abductors draws that fragment toward the wrist. (Fig. 1.) It is therefore advisable in as small a bone as the phalanx to align the distal fragment with the proximal fragment, submitting to the muscle pull rather than trying to overcome it.

## CASE REPORT

Mr. H. A. C. age 50, was struck accidentally on the back of the left thumb with a heavy piece of wood on March 14, 1936, by his son. The son, believing it dislocated, tried to correct the deformity.

Examination showed an abrasion of the back of the hand 1½ inches in diameter over the metacarpal bone proximal to the thumb, deformity of the proximal phalanx of the thumb. The abrasion was treated and dressed. Traction was applied to the thumb and it was immobilized in extension. A roentgenogram showed marked deformity. (Fig. 2.) A reduction was then attempted under general anesthesia and the thumb immobilized in a flexed position. A rolled-up one inch bandage was placed flat in the palm of the hand. (Fig. 3.) After padding, the thumb was fixed against the bandage, using elastic adhesive longitudinally on the back of the thumb in order to get a certain amount of continuous traction. When the dressing was

Fig. 2. Thumb immobilized in extension. Deformity present.

Fig. 3. Diagram of dressing. Thumb flexed on 1 inch bandage, held by strip of elastic adhesive.

completed the thumb was pointing toward the metacarpophalangeal joint of the fourth digit and the interphalangeal joint of the thumb was slightly flexed. The entire hand was included in the bandage in order to enforce adequate rest for the injured part. Roentgenogram was again taken and showed satisfactory position. (Fig. 4.) The dressing was repeated a week later. Two weeks after the fracture occurred a molded volar splint of wire netting was substituted and infrared treatment was given. After twenty-five days the thumb was wrapped in a bandage for support without a splint. Complete functional efficiency was restored after physiotherapy and active motion.

Fig. 4. Roentgenogram of Figure 3. Deformity corrected.

## COMMENT

An uncommon phalangeal fracture case is reported. The principles followed in the treatment of the case are well established. Their application to fracture of the proximal phalanx of the thumb is worth recording. The dressing used is illustrated.

# GUNSHOT FRACTURE OF THE MANDIBLE: CASE REPORT*

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IT is conceded generally that gunshot fractures of the mandible are less amenable to treatment than those originating from other causes. Almost invariably suppurative processes are a complication which seriously impedes an osseous union of the fragments with good occlusion. In the case herewith reported, however, firm union of the fragments, with satisfactory occlusion of the teeth, was obtained fifty-seven days after the injury, although infection elsewhere in the jaw persisted for several weeks.

FIG. 1. Double compound fracture of the right side of the mandible caused by gunshot.

W. N., white male, aged 38, was admitted to the General Hospital several hours after having been wounded by the shell of a shotgun fired

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at close range. The discharge struck the right side of the face about 3 cm. in front of the tragus and scattered. One of the larger slugs had apparently traversed the right infraorbital region and had come to rest at the frontal process of the maxilla close to the nasal bone. Two others of the larger slugs were deflected to the left and had lodged at the base of the cranium. In addition to these, several good-sized pellets remained in the vicinity of the coronoid process, and a number of small pieces had entered the cheek, some staying embedded in the soft tissue and others passing through into the palatal region.

At the time of examination, the patient was found to be fully conscious, weakened, but not in a state of shock. There was a generalized swelling of the right side of the face, numerous powder burns, and, in the masseteric area, considerable laceration and tearing which was seen to include the gingiva of the lower jaw. An inferior orbital ecchymosis was present on the right side, but there was no evidence of ocular involvement. Slight bleeding continued from the mouth and nose. With difficulty the mouth was opened about an inch, showing a 4 cm. gash on the dorsum of the tongue and a grossly edematous condition in the pharyngeal area. The right lower third molar and the right upper first molar were loosened, but did not appear to warrant extraction. In the bony structure itself beside a loss of tissue in the coronoid process and ramus, subsequently confirmed by skiagrams, there was a fracture just anterior to the right angle, and a second near the neck of the condyle—the latter, however, not being displaced. At no time were there indications of brain complications.

Under ether anesthesia, primary cleansing was done, followed by the removal of several slugs. The skin was closed loosely with silk and drainage established. Because of their location it seemed advisable to leave the slugs in the nasal and cranial regions *in situ*. After six days, during which time the oral cavity was put into as hygienic a condition as circumstances would permit, the fracture near the angle was reduced under avertin anesthesia, and the jaws were immobilized by intermaxillary fixation. Nine days after fixation of the jaws, a thick yellowish pus was noted at the site of the angle fracture. *X*-ray revealed a long, thin fragment, together with several smaller spicules, interposed almost vertically between the fractured ends. Treatment was limited to continued general and supportive measures, although there was an intermittent flow of pus. One week later the apex of the large spicule presented on the buccal aspect of the jaw in the line of fracture, and the fragment was easily removed. For the next two weeks small bone spicules were extruded spontaneously, but there was no further appearance of pus at the fracture site and healing proceeded uneventfully until *x*-ray showed osseous consolidation of the fracture.

## CONCLUSION

In this case of gunshot fracture with subsequent infection, bony union was reasonably rapid despite persistent inflammatory processes about the soft tissues and alveolar structures adjacent to the mandibular bicuspid and molar teeth.

Although pus was present at the fracture site, fixation appliances were not loosened until osseous union had been achieved.

# BRODIE'S ABSCESS

## PAIN DISTRIBUTION, OCCURRENCE AND DIAGNOSIS

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BRODIE'S abscess has been defined as a circumscribed area or cavity usually occurring near the epiphyseal end of bone, filled with serum or pus, lined by a well-defined membrane, and surrounded by sclerosed bone with a tendency to obliterate the medullary cavity.

Dudley believes that Brodie's abscess should only refer to that abscess occurring in an otherwise normal bone, and that abscesses occurring with an osteomyelitic process should be called bone abscesses. Bevans says; "A Brodie's abscess, as I use the term, is a small and usually deep situated abscess in the bone without any extensive fistula and without any extensive osteomyelitis or necrosis."

In October, 1824, a patient came to Dr. Benjamin Collins Brodie with an enlargement of the right lower extremity. He was in constant pain, which was always sufficiently distressing, but liable to more severe paroxysms. These paroxysms of pain recurred at irregular intervals. The patient had suffered this condition for twelve years.

Due to the severe pain and the inability to relieve it, the leg was amputated. The amputated leg was divided longitudinally, exposing a cavity in the lower end of the tibia, about one-third inch above the ankle joint. The cavity was about the size of an ordinary walnut and was filled with a dark coloured pus. The surrounding bone was white and of a harder texture. The patient recovered without any more trouble.

Two years later Brodie encountered a similar case. This time he opened the tibia but found no pus. The pain, however, recurred in about a year and a half, and another operation was performed. This time, a definite pus cavity was found. After this second operation, the pain never reoccurred.

Since Brodie's original paper, much has been written on this subject. The literature makes it plain that some men diagnose a lesion as a Brodie's abscess whereas others with an identical case would make a diagnosis of chronic bone abscess. In other words, the statement of Gross in 1901 is still true; "The hope that, with the solution of the etiological question which would decidedly classify Brodie's abscess as an atypical form of acute osteomyelitis and at the same time would give an explanation of its peculiar symptomatology, has not fulfilled itself."

The most frequent etiological agents seem to be the staphylococcus aureus. Others found are the typhoid bacillus, streptococcus hemolyticus and staphylococcus hemolyticus. Some have thought these to be tuberculous, but it is now known that they are not. Henderson and Simon report that in five cases tests for tuberculosis were negative.

Wilensky says; "Brodie's abscess has its origin in a thrombo-phlebitis developing around a thrombo-embolus arrested in a terminal vessel of the vascular network of the diaphysis of a long bone." He believes these abscesses to be the end-result of one of the manifestations of acute osteomyelitis.

Ogilvie says; "The primary lesion is a justa-epiphyseal strain, a partial injury at the very vascular area, plus general lowered resistance in the presence of foci elsewhere."

Myers believes chronic bone abscesses are often, if not always, the residual from an osteomyelitis. Brickner and Phemister believe that localized osteomyelitis may

begin "silently" and proceed to the stage of complete destruction of the bony area involved, with surrounding new bone formation before there are any local symptoms whatever. Mumford thinks these abscesses are a form of osteomyelitis. Marbury and Peckham cite a case of Brodie's abscess of the radius which was proven to be due to typhoid bacillus. Wagner believes these abscesses are due to an *epiphysitis of childhood.*

Trauma is thought by many writers to be only an indicator, or to have only a contributory part. Painter, however, calls attention to the fact that osteomyelitis of the flat bones and tuberculosis of the pelvic joints are rare. He brings out the point that these parts are protected from trauma by the laxity of the joints and the thick musculature of this region, and that this is a point in favor of trauma. Another argument in favor of the trauma theory is that most Brodie's abscesses occur in the lower end of the tibia, which is injured frequently. However, in only six cases out of thirteen reported at Mayo Clinic, was there a history of trauma given.

## PATHOLOGY

Thomson, who studied specimens and cases, divides the stages of the lesion into the following:

First, the quiescent focus. The cavity is minute, filled with serum, lined by a well-defined membrane resembling the periosteum of young bone. The new bone is of a spongy variety, while further away the old bone is sclerosed and the medullary cavity obliterated.

Second, the mature stage, or stage of abscess. Here the membrane becomes converted into granulation tissue and the serous contents are transformed into pus.

Third stage. The abscess perforates the shell of bone and the pus is discharged externally. With the pus leaving the cavity, an equilibrium is formed. That is, there is neither any tendency of the cavity to increase in size nor to become filled up with new bone, and so it undergoes cure.

It is interesting that Thomson and Gross differ as to the cause of change from the quiescent focus to the mature stage. Gross believes that the essential factor is to be found in the sequence of changes in the bone. He believes that with the sclerosis of the surrounding bone, the blood supply to the infective agents is cut off and they lose their virulence. He thinks also that there is sufficient irritation to cause a reactive sclerosis in the surrounding bone even after the medullary infection has been encapsulated. Thomson, on the other hand, believes that the infective agents upon entering the bone marrow are walled off by granulation tissue and overcome, as happens with any infection.

## DIFFERENTIAL DIAGNOSIS

*Bone cyst* lacks the surrounding sclerotic bone, spontaneous fractures often being the first indication of the presence of a lesion. There are no night pains, and there is absence of the local tenderness.

*Chronic sclerosing osteitis* involves the medullary portion of the bone rather than the ends. It is often accompanied by fever and leukocytosis, and gives a rather typical Roentgen-ray picture of spindle-shaped enlargement of the shaft, thickening of the cortex, and narrowing of the medullary cavity. The typical area of rarefaction is absent.

*Sarcoma* of the bone is generally a rapid growing tumor which metastasizes early through the blood stream to the lungs. The pain is less severe; it occurs more often in children than Brodie's abscess; there is enlargement of the veins on the surface of the skin; the onset is acute; in some cases there is pain at night, and a somewhat increased local and general temperature and leukocytosis. Roentgen-ray shows no localized area of rarefaction, but shows a process more extensive and more destructive in character, and there is usually a tumor with an irregular blurred outline.

*Syphilitic Osteitis and Periostitis.* Here a careful history as to a primary lesion, as well as a Wassermann test must be taken.

Syphilis of the bone is rarely a destructive process. If it destroys at all, it erodes from the periphery. A somewhat similar area of softening may occur with gummata, but the surrounding bony wall is soft and not hard. Both may have night pains. In Brodie's abscess, the night pains are more intermittent and changeable in intensity, while in syphilitic osteitis, when once the night pains have begun, they are persistent and increase in a consistent ratio, finally becoming intolerable.

*Tuberculosis* of the bone is a destructive process, leading early to sinuses and sequestra, whereas Brodie's abscess is a productive, sclerosing one. The periosteum is rarely thickened in tuberculosis of the bone. In tuberculosis, there is a lack of repair power, and laboratory work with animal inoculation might be necessary before a diagnosis could be made.

*Scurvy* in children with periosteal overgrowth may confuse, but this is not a destructive process.

*Rheumatic and Arthritic Conditions* will have to be excluded. Usually, a careful history, physical examination, laboratory study will make the diagnosis. But in some cases, only roentgenograms will establish the diagnosis.

## DIAGNOSIS

Some of our cases gave a history of trauma, with pain gradually becoming worse following a varying period of time. Pain in several cases occurred at night. Usually on examination there was swelling and tenderness. Roentgen-ray showed a rarefaction in the bone surrounded by sclerosed bone. This triad, severe pain, localized bone tenderness, and the roentgenographic findings are characteristic of Brodie's abscess.

The following case histories represent twelve cases of Brodie's abscess studied rather extensively from the Services of the Hospital for Ruptured and Crippled. The *x*-ray pictures of Cases X, XI and XII are presented as the most characteristic representations of Brodie's abscess in different locations. These three cases also illustrate the great difficulty in arriving at the proper diagnosis.

Case I. Andrew T. Age 9 years. Admitted to the Hospital Aug. 18, 1933. For the past three weeks has had pain in the left groin, following a fall. The pain gradually became worse and patient came into the hospital for treatment.

*Examination:* Patient looks sick. Has temperature of 102°. There is muscular spasm about hip and knee but no limitation of motion. There is tenderness at the lower end of the femur. *X*-ray shows a lesion of the lower end of the femur with a rarefaction and surrounded by sclerosed bone.

*Diagnosis:* Brodie's abscess of the left femur.

*Treatment:* The lower end of the left femur explored through an incision about two inches above the knee. On the anterior and medial border of the femur, there was roughening. A small opening which was enlarged, was made in the femur, exposing a cavity which was filled with a greyish, thick and purulent material. The lining of the lesion was curetted thoroughly and wound closed in layers.

*Check-up Examination:* Nov. 6, 1935, three years later. No tenderness and no limitation of motion. Only slight pain when there is a change in the weather.

Case II. Frank H. Age 16 years. Admitted to the Hospital Jan. 22, 1935. Five years ago he had an infection on the sole of his right foot, and about ten days later he had localized swelling and redness in the region on his right ankle. Later, he had some swelling and redness just above the right knee and in the groin. Hot fomentations were applied and this cleared up the leg without any operative interference. Patient was free of symptoms until the past year, when he sprained his right ankle in inversion. Since then there has been some swelling just above the right ankle, with considerable throbbing pain, which does not wake him at night, but is usually present all day.

*Examination:* Swelling and tenderness is present about the right ankle. There is a localized point of tenderness about one inch behind and one inch above the internal malleolus. Ankle movements are normal, legs are the same length, there is no atrophy and Kline test

is negative. *X*-ray shows a lesion in the lower third of the tibia which was diagnosed as a Brodie's abscess.

*Diagnosis:* Brodie's abscess of the lower end of the tibia.

*Treatment:* On Jan. 24, 1935, the right leg was operated on. An area was found corresponding to that seen in the *x*-ray. In this cavity was found some whitish material and a few drops of pus. The cavity was curetted and closed in layers.

*Check-up examination:* Dec. 12, 1936, eleven months post-operative. Motion of the ankle is normal. There has been no return of the pain. There is no redness or tenderness.

CASE III. Edward R. Age 11 years. Admitted to the Hospital March 27, 1935. For the past year, he has had pains which were more or less all over the anterior and medial aspect of the left femur. The pain was of a dull, aching character, worse in damp weather, coming on usually around 5 A.M. At times this pain would wake him at night. Before he came to the hospital, this condition had been diagnosed as rheumatism, and growing pains. An appendectomy gave no relief. Just before coming into the hospital, the pain became more severe, and at times caused him to cry at night. He lost 10 pounds in two months.

*Examination:* Patient walks with a limp on the left. There is one-half inch atrophy of the left thigh. There is no swelling or redness. However, there is one point of tenderness over the inner aspect of the femur. Kline test was negative.

*Diagnosis:* Brodie's abscess of the lower end of the left femur.

*Treatment:* On April 4, 1935, the left femur was explored. A cavity was found, which contained some pus. The bone was found eburnated and of a white color. The cavity was curetted and the wound closed in layers. A small rubber drain was inserted just under the skin. This was removed the next day.

*Check-up examination:* Nov. 22, 1936, year and a half later. No limp and no pain after the incision healed. Knee joint function was normal. There is no tenderness and no swelling.

CASE IV. George S. Age 11 years. Admitted to the Hospital Aug. 13, 1935. Two and a half years ago, this boy was struck on the right leg by a pail. The leg became painful and swollen over the lower third. The pain occurs only in the day, and has never been very severe. However, the pain has lately become worse and it has occurred at night.

*Examination:* There is a tender point about three inches above the right ankle. Some

CASE COLLECTED FROM THE LITERATURE

| Location | Thomson's | Gross | Mayo Cases and Those Collected by Henderson and Simon | Collected from the Literature | Total |
|---|---|---|---|---|---|
| Upper end of tibia | 63 | 55 | 10 | 3 | 131 |
| Middle of tibia | 2 | .. | 1 | 1 | 4 |
| Lower end of tibia | 42 | 35 | 17 | 3 | 97 |
| Tibia (portion not stated) | 1 | 11 | 3 | 9 | 24 |
| Lower femur | 18 | 15 | 3 | 5 | 41 |
| Humerus | 18 | 16 | 2 | 4 | 40 |
| Radius | 4 | 4 | 1 | 3 | 12 |
| Ulna | 2 | 2 | .. | 1 | 5 |
| Scapula | .. | .. | .. | 1 | 1 |
| Vertebra (spinous process) | .. | .. | .. | 1 | 1 |
| Not stated | 11 | .. | 2 | .. | 13 |
| Tibia and fibula (lower) | .. | 1 | .. | .. | 1 |
| Upper tibia and lower fibula | .. | 1 | .. | .. | 1 |
| Head of humerus | .. | 1 | .. | .. | 1 |
| Fibula | .. | .. | .. | 1 | 1 |
| Pubic bone | .. | .. | .. | 1 | 1 |
| Total | .. | .. | .. | .. | 374 |

thickening of the tissues in this area. There is no redness or increased heat. Kline test is negative.

*Diagnosis:* Brodie's abscess of the lower end of the tibia.

*Treatment:* On Aug. 14, 1935, the right leg was explored. A cavity was found containing dark material. This was curetted and the wound closed in layers.

*Check-up examination:* Sixteen months later. The legs are the same length, the ankle joint motion is normal, there is no pain, no swelling, and no redness.

Case v. Douglas R. Age 14 years. Admitted to the hospital March 15, 1934. He has had a weakness of the left ankle for one year. The last six months, he has had intermittent pain which gradually became worse, waking him at night, and being particularly acute during damp weather.

*Examination:* There is some swelling of the lower part of the left leg. There is no increased heat or definite point of tenderness. *X*-ray shows a lesion suggestive of Brodie's abscess.

*Diagnosis:* Brodie's abscess of the lower end of the left tibia.

*Treatment:* On March 15, 1934, the tibia was explored. There was found a thickened cortex, and a cavity containing yellow pus. The area was curetted and packed with vaseline gauze.

*Check-up examination:* Nov. 23, 1936, nearly three years after the operation. There has been no pain, there is no swelling and there is no tenderness. The motion of the ankle is normal.

Case vi. Mary M. Aged 14 years. Admitted to the hospital Aug. 22, 1934. Patient fell on the street on June 14, 1934, receiving bruises of the left knee and lower third of the leg. The pain has been more or less continuous just above the ankle, coming on at night, with some tenderness and swelling of the leg above the ankle. Symptoms gradually became worse. The diagnosis of flat feet had been made at one time.

*Examination:* There is some swelling of the lower left leg. There is also some tenderness to deep pressure. Temperature is 100°. There is no redness of the leg. *X*-ray examination shows a Brodie's abscess of the lower end of the left tibia.

*Diagnosis:* Brodie's abscess of the lower left tibia.

*Treatment:* On Aug. 23, 1934, the left tibia was explored. A cavity was found surrounded by sclerosed bone, but there was no pus. The cavity was curetted and packed with vaseline gauze.

*Check-up examination:* Two years later, Dec. 5, 1936. There has been no pain except during damp weather. No tenderness or swelling.

Case vii. Anna G. Age 18 years. Admitted to the Hospital Jan. 5, 1935. Five months ago, patient hit her right leg on her bed at home. The pain was so severe that it caused her to cry momentarily. Since then, pain has gradually become worse, and occurs at night. At night, the pain is needle-like and relieved by rubbing her ankle.

*Examination:* There is a painful area about one and a half inches above the internal malleolus, with no swelling or redness. Right calf shows a half inch atrophy. *X*-rays shows a cavity in the right tibia, which is diagnosed as a Brodie's abscess.

*Diagnosis:* Brodie's abscess lower end of the tibia.

*Treatment:* On Feb. 6, 1935, the right tibia was explored. The periosteum was found to be raised. No free pus was found, and wound was closed in layers.

*Check-up examination:* Dec. 12, 1936, two years later. Motion of the ankle joint normal, no pain, no swelling, no tenderness.

Case viii. Robert P. Age 7 years. Admitted to the Hospital Oct. 14, 1935. Eight months ago, he fell over a wheelbarrow, injuring his testicles, and complaining of some pain in the left hip. However, this soon went away. About one month after the injury, the patient began to complain of a dull pain in the left hip. The pain would also wake him at night and the leg would be rubbed with Chloroform Liniment. About August, 1935, the patient developed a limp in the left hip, and the pain became more severe. His physician diagnosed the condition as rheumatism. An *x*-ray was taken which showed a Brodie's abscess of the femur.

*Examination:* As patient walks, there is a definite limp on the left. The left lower extremity shows some atrophy. There is a flexion contraction of thirty degrees of the left hip. All motions of the left hip are limited. There is tenderness and induration of the upper left thigh.

*Diagnosis:* Brodie's abscess of the neck of the left femur.

*Treatment:* On Oct. 23, 1935, the left femur was explored. A cavity of the neck of the femur was found. There was no free pus, but some dark colored material was found. The cavity was curetted, and closed in layers. A small rubber drain was inserted just under the skin.

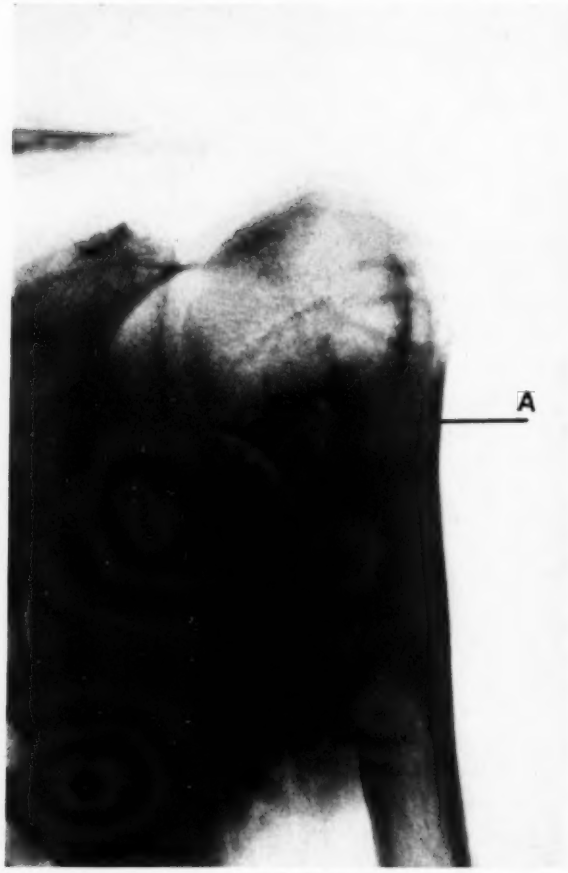


FIG. 1. Arrow A shows a definite circumscribed rarefaction in the upper humerus about one-half inch below the epiphyseal line. There is a marked sclerosis about the periphery of the bone cavity.

*Check-up examination:* Dec. 11, 1936, one year later. There is no tenderness, no redness, no pain. Motions of the left hip are normal, with no limp.

CASE IX. Jack Z. Age 25 years. Admitted to the Hospital July 7, 1936. One month ago, while walking, he had a severe pain in the left ankle, which caused him to go to bed. At that time, the ankle was swollen and the pain would be intermittent. He applied Sloan's Liniment. For the past two weeks, the pain has been more or less continuous, waking him at night. About fifteen years ago, he states he had pain in the left ankle, and was told it was rheumatism.

*Examination:* There is a definite swelling of the left ankle. Movements of the ankle joint are normal. There is tenderness one inch above the internal malleolus. There is some increased heat in this area. *X*-ray shows a Brodie's abscess of the tibia.

*Diagnosis:* Brodie's abscess of the lower end of the tibia.

*Treatment:* On July 10, 1936, the left tibia was explored. The periosteum was found to be adherent to the bone right over the cavity. The cavity contained no pus. The cavity was curetted and the wound closed in layers.

*Check-up examination:* Four months later, Nov. 28, 1936. Wound has healed, ankle joint movements normal, no swelling, no pain, and no redness.

CASE X. Oscar J. Age 24 years. Admitted to the Hospital May 9, 1936. For the past eight years, patient has had pain about the right shoulder, and extending to the arm. He has been treated continuously for rheumatism. The pain seemed to be centered in the shoulder joint itself and radiated backwards to the scapula. In the beginning, the pain did not trouble him in the daytime and it was noted only in the early morning, which would cause him to get up and walk about. He has had a thorough search for foci of infection. Tonsils and teeth have been removed and to date the pain is now continuous. It is necessary for him to take certain amounts of codeine daily.

*Examination* is negative except for the right shoulder. The right shoulder girdle shows moderate atrophy. There is, however, no restriction of motion except in abduction. He does handle the shoulder joint with care. There is moderate atrophy of the biceps muscle. The bicipital region in the right measures 10½, and the left 11½. The right forearm measures 9, left 9½. There is no tenderness about the scapula or shoulder joint except about the head of the humerus. Posteriorly, there is no tenderness. With the arm in neutral position, in the region of the sub-scapularis muscle, close to the brachial plexus, there is some thickening and marked tenderness on palpation.

*X*-rays of this region (Fig. 1) show a definite rarefaction circumscribed in the medial aspect of the humerus about one inch from the shoulder joint. There is considerable calcium laid down on the outer surfaces of this area.

*Diagnosis:* Brodie's abscess right upper humerus.

*Treatment:* The right humerus was explored. A small window was made in the medial and anterior surface of the humerus and the abscess cavity located. It was filled with a gelatinous, reddish looking material, which was curetted out. All rough edges were removed and the wound closed without drainage. Patient made an uneventful recovery from operation, and volunteered the information the following morning that his old pain was gone.

*Check-up examination:* *X*-rays taken two years later show the cavity to have filled in with new bone, and the patient is symptom free.

*Analysis* of the above pain findings could lead one to suspect a brachial plexus syndrome, either by pressure or imflammation of the nerve roots. The tenderness and atrophy of the arm and the slight restriction of motion leads one to suspect arthritis. The true cause of pain was noted only by the *x*-ray findings.

Case xi. Russel DeS. Age 24. Admitted to the Hospital Dec. 10, 1934. Patient is a British West Indian, who for the past five years has had pain in the left joint region. Pain at times radiated to the hip and ankle, and he had considerable difficulty in walking. He had some restriction of motion, especially external rotation of the hip. Pain had been intermittent in character and was partially controlled by aspirin. For the past ten months, pain has been almost unbearable. He has consulted a great many physicians and *x*-rays were taken and called negative.

*Examination* reveals patient to be in splendid physical condition. There is no evidence of polyarthritis about the terminal joints. Examination is concentrated on the left lower extremity. There is moderate atrophy of the left thigh, and patient walks with a left limp. There is restriction of external rotation and extension of the left thigh. There is some tenderness on deep palpation in the region of the lesser trochanter. Forced movements give the patient pain. A thorough laboratory examination reveals blood count, blood chemistry and urine within normal limits. Spinal fluid, normal pressure, protein 27, and manometric examination normal.

*X*-ray of the entire body showed nothing unusual except in the region of the lesser trochanter of the left femur about one inch from the hip joint (Fig. 2), where a definite rarefaction at the base of the lesser trochanter, measuring about 1 cm. in width with sclerotic changes in the surrounding bone was noted.

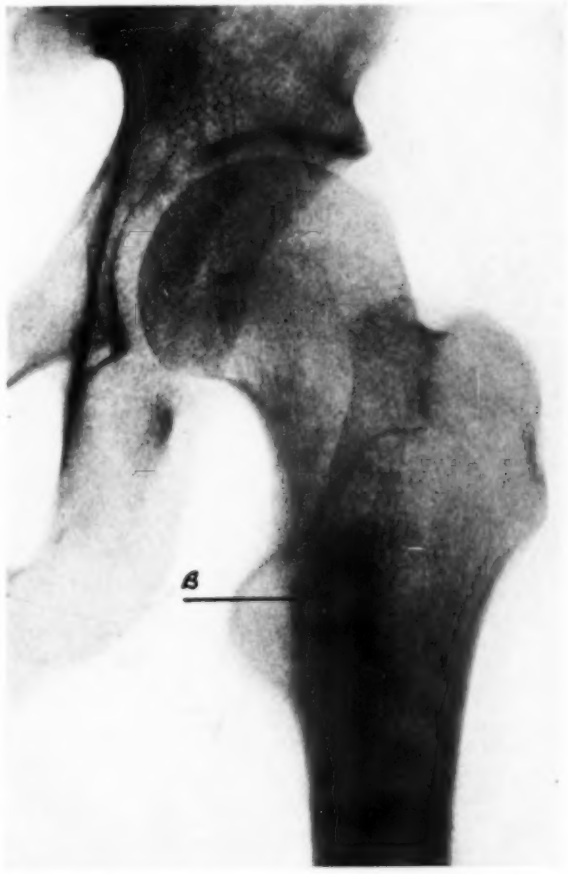


Fig. 2. Arrow B shows a cavity in the region of the lesser trochanter of the femur. Marked sclerosis surrounding the bone cavity which is close to the old epiphyseal line.

*Diagnosis:* Brodie's abscess of lesser trochanter left femur.

*Treatment:* The following morning, the left hip joint region was explored through an anterior incision. Definite sclerotic changes were noted in the periosteum about 1″ above the lesser trochanter. A window was made in the bone in this region, and an abscess cavity was encountered. The cavity was filled with sero-purulent material and considerable semi-solid material. The surfaces were curetted very thoroughly and the wound was closed without drainage. Cultures from the wound were negative and microscopic examination of the fragments of bone and granulation tissue revealed necrotic bone and chronic inflammation.

*Check-up examination:* Patient was examined two years later and has complained of no further pain. Normal motion has been restored

to the hip joint and he has gained 20 pounds in weight.

*Analysis* of the above pain findings leads one to suspect a sciatic syndrome, the pain in the hip being caused by an inflammation of the lumbo sacral roots, as there was only slight limitation of motion in the hip and the severity of the hip joint could not be noted because of overlying musculature. The diagnosis of arthritis was suspected. Because the patient took aspirin continuously, drug addiction was considered, and only by *x*-ray study was the nature of the lesion discovered.

Fig. 3. Arrow c shows cavity and rarefaction about the internal malleolus within the old epiphyseal line. There is marked sclerosis surrounding the bone cavity.

Case xii. Rupert Z. Age 34 years. Admitted to the hospital June 30, 1930. For fourteen years he has had attacks of pain from time to time which laid him up for one or two days. The pain at times has almost been unbearable and his treatment has always been for arthritis. Tonsils have been removed. His gastro-intestinal tract has been explored. Many teeth have been removed without any improvement. Six weeks previous to admission to the hospital, he had had a very severe attack of increased pain, swelling and heat about the ankle and was unable to continue with his work. Examination at that time showed patient to be in good condition and in considerable pain.

*Examination* was negative except for the right lower leg. There was considerable thickening and swelling about the ankle joint. The greatest edema seemed to be around the internal malleolus. Motions of the joint were markedly limited. He had no fever.

*X-ray* showed a definite rarefaction in the lower end of the tibia (Fig. 3). There was marked periosteal thickening. This rarefaction measured about 1 × 1½ cm. The abscess cavity was very close to, if not communicating with, the ankle joint.

*Diagnosis:* Brodie's abscess lower end of the tibia.

*Treatment:* The following morning the internal malleolus was explored through a longitudinal incision. There was moderate thickening about the periosteum. A small window was made in the tibia and the abscess cavity entered. Definite sero-purulent exudate exuded and on culture revealed staphylococcus albus. The wound was thorough curetted. All loose bone was removed and, because of the acute inflammation at the time, the wound was drained.

*Check-up examination* in April, 1937, seven years after operation, revealed that the patient has been absolutely free, with normal motions in the ankle. Swelling has disappeared and to date both ankles measure the same in circumference. There is no disturbance of motion in the ankle joint and *x*-ray shows consolidation of the bony cavity.

*Analysis* of the above findings leads one to think only of chronic monarticular infectious arthritis with acute exacerbations. It is strange that the patient suffered eighteen years (three years in war duty) and no physician suggested *x*-ray, by which the diagnosis was made.

## SUMMARY

There were ten males and two females in this series. All of the patients complained of pain. In eleven cases, there was tenderness (91.6 per cent). In eight cases there was swelling (66.6 per cent). In seven cases,

there were both tenderness and swelling (58.3 per cent).

In seven cases, there was pain at night which usually awakened the patient. In seven cases also, there was definite pus formation found in the cavity. In two cases, there was found material that was not definitely said to be pus, and in two cases there was no reference as to what was found.

It is interesting that, out of the twelve cases, six, or 50 per cent, gave a history of injury to the part affected. In eight cases, the cavity was closed tightly after operation. In two cases, the cavity was closed, but a small rubber drain was put under the skin. In two cases, the cavity was *packed* with vaseline gauze.

In seven cases, the Brodie's abscess was located in the lower portion of the tibia (58.3 per cent); in the lower part of the femur in two cases; in the neck of the femur in one case; in the humerus in one case; and at the base of the lesser trochanter in one case.

Check-up on these patients ranged from three months to seven years. In all of these cases, there was no return to pain, the joint motion was normal, the part affected was normal except in one or two cases which gave a history of a little pain when the weather was damp. The Kline test and blood examinations were normal in these patients. Before coming to the hospital, such diagnoses as flat feet, neuritis, or rheumatism and growing pains had been made.

## COMPARISON OF THESE CASES WITH OTHER CASES

In 145 cases reported by Thomson, 122 cases (84.2 per cent) gave a history of osteomyelitis in childhood. In thirteen cases reported by Henderson and Simon of The Mayo Clinic, only two gave a previous history of osteomyelitis.

In this series of twelve cases, only one gave a history suggestive of possible osteomyelitis: that patient's condition, however, subsided with hot fomentations alone. The lower end of the tibia was involved in 50 per cent of our cases.

We believe that Brodie's abscess is a definite clinical entity. Trauma is an important predisposing factor in the cause of an epiphysitis. A definite Brodie's abscess can be cured by curetting the cavity and closing the wound tightly. The definite history of pain becoming worse, occurring in most cases at night, associated with tenderness, and often swelling of the part affected, helps to establish the diagnosis. The *x*-ray picture is important and shows a characteristic picture of rarefaction, which is surrounded by sclerotic bone. It is important to get dense films and films taken in several positions, as some Brodie's abscesses are missed by under-exposed films and overlying bone might be preventing a view of the Brodie's abscess. We have had cases in which both of these factors caused some delay in making the proper diagnosis. Lastly, these abscesses should not be called *Chronic Bone Abscesses*, which belong to the abscesses caused by osteomyelitis, but should be called *Brodie's abscess*.

Once the diagnosis of *Brodie's abscess* has been definitely made, the prognosis is much better than if the diagnosis is *Chronic Bone Abscess*, as, in the former, *correct operation will cure*, whereas, in the latter, it might be only the *beginning* of a very *long, difficult case of osteomyelitis*.

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# TUBERCULOUS PYOPNEUMOTHORAX

## UNUSUAL CASE REPORT

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THE serious nature of mixed tuberculous empyema complicating pulmonary tuberculosis is well known. Its presence is usually secondary to an induced or spontaneous pneumothorax and in this regard is often spoken of as tuberculous pyopneumothorax. In 1931, the Committee on the Treatment of Tuberculous Empyema reported that without adequate surgical collapse 61 or 75 per cent are dead, or the figures may be worse, depending on whether closed or open drainage is used. With adequate collapse in experienced hands 55 per cent will be cured and only 43 per cent will die. Operation must be done with consideration for the underlying pulmonary pathology, and any operation attempted to control the empyema alone will have disastrous consequences. Thus, Archibald has effectively classified the mode of attack on tuberculous empyemata into two principal groups; those with gross or cavernous pulmonary findings, and those without. The former group constitute the majority by far, and require surgical collapse for the pulmonary as well as the pleural disease. Such collapse must be radical and complete, and is better borne in multiple stages. A few tuberculous empyemata without mixed infection will tolerate oleothorax with gratifying success, but it cannot be used in the mixed type which have origin in broncho-pleural fistula.

The following case is reported, not as an unusual entity, but as an example where both surgery and oleothorax were utilized with success.

A negro male, A. K., aged 19, was first admitted to the Jefferson County Tuberculosis Hospital Sept. 19, 1934 with a diagnosis of far advanced pulmonary tuberculosis. His disease was not suspected or diagnosed until July, 1934, when he was being examined for life insurance. There were no symptoms except a slight cough with occasional thick yellowish-grey sputum. There was no history of fever, chest pain, or loss of weight.

Examination on admission was essentially negative except for the pulmonary findings which were limited to the left lung. Roentgenograms showed a 5 cm. cavity in the left infraclavicular area and a 2 cm. cavity in the lower pole of the left upper lobe. In addition, there was moderate exudative inflammation throughout the whole left lung. The right lung was normal except for some enlargement of hilar glands. (Fig. 1.)

Laboratory studies revealed nothing of importance except a positive sputum, Gaffky IV, ranging in amount from 3 to 4 ounces daily. Serology was 4+ by various methods (Kahn, Lewis, Kline, Wassermann).

He was placed on conservative regimen including Mapharsen and bismuth salicylate in block doses for lues, and his course was uneventful until March 7, 1935, when he suddenly developed a sharp pain in his left lung and marked dyspnea. Temperature rose from normal to 103°F. At this time I was called as a consultant, and there was evidence of a marked tension pneumothorax on the left. The heart was pushed far into the right thorax, the left intercostal spaces were bulging and there was a conspicious distention of the left epigastrium. A needle was thrust into the left pleural space and gradual decompression effected. Roentgenograms showed a fluid level to the seventh rib posteriorly, and on culture a mixed growth of organisms was obtained including tubercle bacilli (smear.)

It was apparent that drainage was imminent to allay absorption of the mixed infection, with proposal for surgical collapse to the underlying pulmonary and pleural cavities as soon as his condition justified it. Therefore the following

day, a closed thoracostomy was performed under local anesthesia placing a tube in the tenth interspace postero-laterally. Large amounts of foul, yellowish-green pus varying from 600 c.c. to 700 c.c. daily were obtained at the onset; by the eleventh day it had reduced to 150 c.c. A left permanent phrenicectomy was performed March 28th, but fever continued high (102°–104°F.).

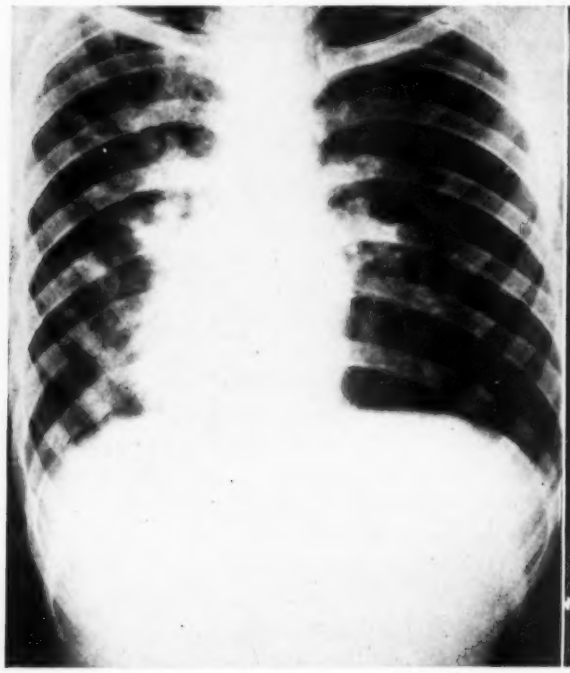

Fig. 1. Roentgenogram of chest, Sept. 20, 1934, showing large cavity left upper lobe, and smaller cavity beneath.

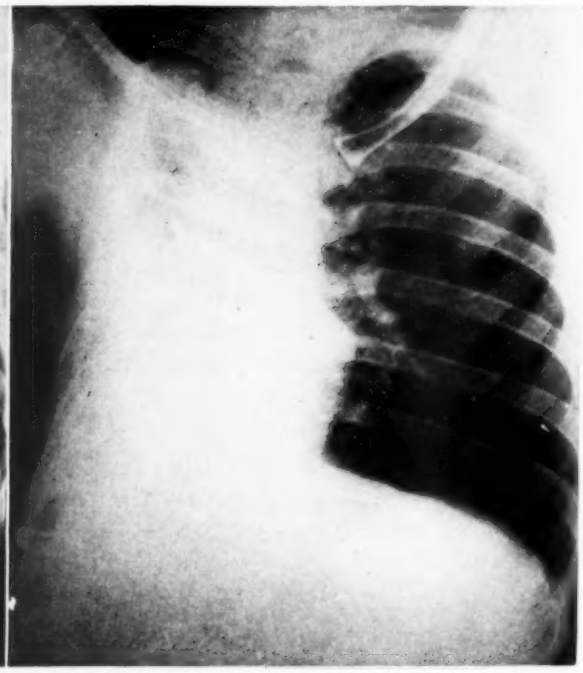

Fig. 2. Roentgenogram of chest following thoracoplasty, April 21, 1936. Safety pin in lower left represents location of cork plug withholding oleothorax.

First stage thoracoplasty was performed under nitrous oxid-oxygen using a Wilms-Sauerbruch technique and removing short segments of the first five ribs posteriorly. Temperature receded slightly but still varied 100°–102°F. with pulse rate of 130. By June 11th, the second stage was completed and we were gratified to find a gradual improvement in the patient's condition in the succeeding days in spite of a surgical collapse which we would consider inadequate today.

By May 23rd, temperature and pulse were within normal limits and there was no cough or sputum. There was however, a pleuro-cutaneous fistula from the thoracostomy wound which led to a pleural sinus of a capacity of 150 c.c. The drainage from this sinus, however, remained constant at 20 c.c. and was composed of a mixed flora. Figure 2 shows the Roentgen findings.

After three months of asymptomatic response, it was thought that a Schede operation would eventually be necessary to close the pleural sinus. After some deliberation, oleothorax was given a trial, consisting of 150 c.c. of sterile cottonseed oil with 5 per cent gomenol, placing a small cork plug tightly into the outlet of the sinus, so as to retain the oil. This, it was thought, might give the internal portion of the sinus a chance to close. After three days, the reaccumulated pus was drawn off with a needle (40 c.c.) and the same amount of steril oil reintroduced. There was no leakage around the cork, and on the eleventh day following original introduction, the cork was removed. The sinus had closed as was hoped for, and the patient suffered no return of untoward symptoms regarding either the pulmonary or pleural entities.

This patient was classified as arrested tuberculosis Dec. 15, 1935, and has been doing light labor every since. He was re-examined Nov. 30, 1936 and has had no recurrence of tuberculosis. It is interesting to note that his serology became entirely negative after approximately one year of anti-luetic therapy.

There is much to be learned by one's mistakes and we came upon the idea of

accomplishing this treatment through one of the common errors in the treatment of empyema; i.e., the use of too short a drainage tube will frequently cause obstruction to the outlet in the chest wall. The cork was utilized with this common error of technique in mind, that if the internal portion of the sinus were left to close, it would eventually serve to retain the oil in the pleural cavity. Any re-formed pus could be easily controlled by aspiration with a needle and syringe until it was cleared up.

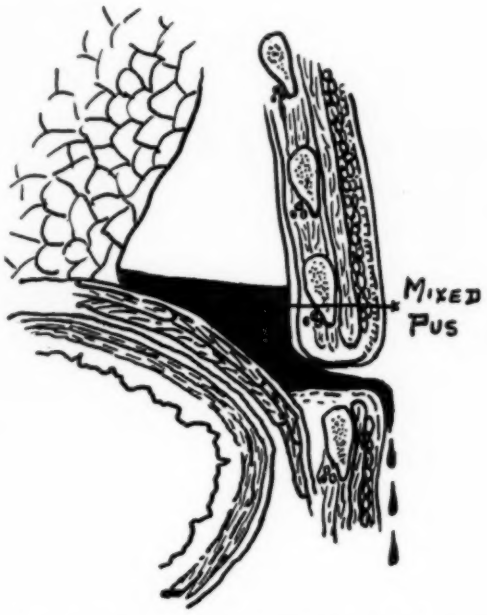


Fig. 3. Showing mixed empyema witht horacostomy sinus.

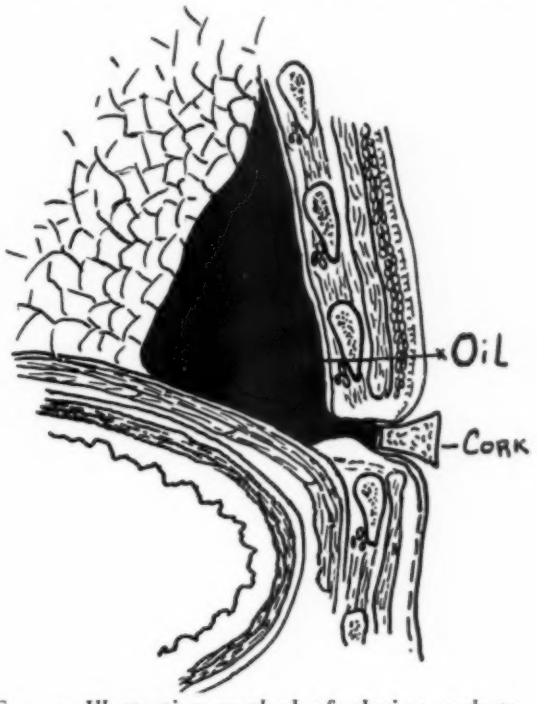


Fig. 4. Illustrating method of placing cork to retain sterile oil in pleural cavity.

This case also exemplifies a mistake that, if obviated, may have effected a cure without oleothorax. That is, the Wilms-Sauerbruch operation is not sufficiently radical to close a tuberculous empyema, let alone any form of cavernous pulmonary tuberculosis. It is too uncertain, and we now remove larger portions of ribs as advocated by Alexander and others.

## CONCLUSION

1. A case of tuberculous empyema with cavernous pulmonary tuberculosis is presented exemplifying tension pneumothorax and mixed infection.

2. This case was arrested by use of several modes of surgical attack: Thoracostomy, phrenicectomy, and thoracoplasty.

3. Oleothorax was attempted to correct a remaining empyema sinus, in preference to the more radical Schede operation. This oleothorax was effected by inserting a cork into the external opening of the fistula, so as the internal portion might close first. This procedure was successful.

4. Cognizance is given to the fact that under present-day regimen of surgical collapse, a more radical type of thoracoplasty will give more satisfactory results in tuberculous empyema.

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# THE TRAUMATIZED VERMIFORM APPENDIX

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IN October of 1926, Bruning[1] reported a case of what he termed traumatic appendicitis. Steinthal,[2] in the following year, however, published a paper in which he questioned the occurrence of traumatic appendicitis in no uncertain terms. This was followed within three months by another article of Bruning's, defending his statements of the previous year. The controversy became spirited and has continued in surgical circles throughout the world to the present day. Long before Bruning's report, it was recognized by some men and disputed by others that appendicitis could be caused by trauma, that is, by external violence. Even today the argument has its opponents and proponents, and in the legal courts of many states traumatic appendicitis is not recognized by the learned legal profession. Since Bruning's first report, there have been published reports of twelve apparently authentic cases from different locales. The two cases reported herein bring the total of reported cases to fourteen.

Silberstein,[3] in 1927, and Wilhelm,[4] in 1928, reported one and two cases respectively from Germany. Mortensen and Bray[5] reported an unusual case from Australia, in 1928. Fox and Zerbe[6] reported a case from Germany in 1929; and in 1931, Domenico reported one case from Italy.[7] White,[8] in Minnesota, and Wilson,[9] in Wisconsin, each reported one case, in 1931 and 1932 respectively. In 1932, Mudelman[10] reported a case and argued it from the right to compensation. Daubenspeck[11] reported a case in 1932 from Germany, and Roudil,[12] in 1933, reported a case from France. There have been other cases reported that are, apparently, acute suppurative appendicitis, aggravated by trauma. Auvory and Gerode[13] reported a case, in 1927, in which the appendix was found detached from the cecum and intensely suppurative. Clear-cut evidence is not offered, however, that the detachment was not due to perforation or gangrenous slough at its base as a result of acute disease, a process which may have been hastened by trauma. Within one year we have seen two cases that leave no doubt as to direct injury to the appendix vermicularis.

## CASE REPORTS

Case 1. The first patient was seen in December of 1933. He was a young male, 22 years of age, weighing about 190 pounds, a well-known collegiate football star. He said that he had never been ill previously and that this was his first visit to a physician for professional purposes. Three nights before he had run into a dark room to get his hat, and in hurrying out, he had fallen over an antique chair of fancy design with a wooden frame, with such force that the back of the chair was shattered. The lower right side of his abdomen received the full force of the blow, which, as he termed it, "knocked me cold." His waiting friends heard the fall, and, receiving no answer to their queries, entered the room and found him lying upon the floor with the fragments of the chair under him. He soon recovered consciousness, complained of severe pain in the abdomen, and began to vomit. He suffered chills at the same time. He and his friends state that the right lower quadrant was intensely hard and tender, but there were no marks upon the skin. He decided to remain in bed, but refused to have a physician called, stoutly maintaining that soon he would be all right. During the succeeding two days he took no medication, but continued to eat. The pain in the abdomen became more severe and generalized, and the rigidity became more marked.

When first seen, the patient presented the appearance of advancing generalized peritonitis, and he was therefore advised to go to the hospital immediately, but refused to do so. The next day the vomiting became stercoraceous and he consented to enter the hospital. At first the patient refused operation, and Ochsnerization and localization were attempted. The Wangensteen apparatus was set into motion, and attempt made at localization. The distention was very marked; no peristalsis was heard at any time. By this time the boy's parents arrived at the hospital, and the necessity of surgical drainage was impressed upon them.

At operation the peritoneal cavity showed the typical picture of diffuse, advanced, generalized peritonitis. The viscera were matted together and distended; the appendix and appendiceal mesentery were detached from the cecum. The appendix was not gangrenous. The opening in the cecum, at what had been the base of the appendix, showed a rent about 3 cm. long. The patient died the following day. Autopsy disclosed no other perforation or rent in the viscera.

Case II. In May 1934, we were called to see another young man, 18 years of age. This boy was also a renowned athlete, six feet tall, weighing about 190 pounds. His history, as given, was that he had been perfectly well all his life until the day before. He had been at a swimming pool, and while standing on the high diving board, started to "rough house" friends, as he put it. He was pushed from the diving board in such a manner that his abdomen struck the rebounding board as he fell, turning him over in the air and throwing two others off with him. One of his friends claimed that he fell upon the patient feet first, striking him in the abdomen again. The boy was pulled from the pool unconscious, but he soon recovered his senses on the side of the pool and began to vomit, complaining of severe pain in the right lower abdomen. He was taken home. He failed to tell his parents. During the night the pain became much worse and spread to involve the whole lower abdomen. Early the next morning, his parents heard him vomiting, became alarmed and summoned the doctor. He was sent immediately to the hospital and operated upon for a ruptured viscus. About a quart of purulent material was aspirated from the peritoneal cavity. The cecum was located and the appendix found to be detached at its base. It contained no pus, but a fecalith was found plugging the opening in the cecum, acting as a cork to prevent the contents of the colon from leaking further. A purse-string suture was taken around this area to invaginate. Drains were placed at strategic points and the patient returned to his room. His convalescence was quite stormy, and he left the hospital with a draining sinus. This was removed several months later at a subsequent operation, and he has remained well.

In both of these cases, with the past history of each in mind, it is logical to surmise that the separation of the appendix and meso-appendix was undoubtedly due to trauma. It is said by certain authorities that porters, stevedores, and individuals who earn their livelihood by heavy lifting, are more prone to appendicitis than those with other occupations. There have been many instances of typical acute inflammation of the appendix found at operation, following a forceful blow over the right lower quadrant, in people who previously were perfectly well. This may be due to swelling resulting from the blow, but it is estimated that over 80 per cent have had a history of previous attacks of appendicitis. It is known that interference with the blood supply may cause appendicitis, and certainly localized swelling as the result of trauma may be the origin of such interference with the appendiceal blood supply. In the majority of cases, however, trauma serves to awaken a sleeping dog.

However, in both of the cases here reported, in consideration of the history of the patients and the history of the illness, it would be an exaggeration to state that a dormant appendicitis had been awakened by trauma. Both of these boys were splendid specimens of manhood. Neither had been ill before. There was a definite history of direct injury both to the appendix and meso-appendix. The appendix is a hollow viscus and viscera can be ruptured by external force.

We do not cite these cases to add to already voluminous literature upon appen-

dicitis, but to place both before the profession as a record in proof of the statement that trauma can, and sometimes does, result in tearing off the appendix from its attachment, or at least rupturing it.

SUMMARY

1. The vermiform appendix is a hollow viscus and like all hollow viscera can be ruptured by external as well as internal force.

2. The meso-appendix is a similar structure to the mesocolon and mesentery, any of which may be torn or rent by external violence.

3. The blood supply to the appendix may be occluded by external trauma, causing appendicitis or gangrene.

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"Vomiting must be looked upon as one of the cardinal signs in appendicitis. Analyzing fifty cases of acute appendicitis, I found that vomiting occurred in thirty-six, nausea without vomiting in six and no nausea and no vomiting in eight."
From—"Appendicitis. A Clinical Study," by W. H. Bowen (Macmillan).

# TORSION OF THE OMENTUM

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TORSION of the omentum is an uncommon pathological entity but it is not a rare lesion. More than 300 cases have been reported up to the present time, and new ones are appearing in the literature steadily. This is probably due to an increasing tendency to explore the abdominal cavity, both visually and manually, when the surgeon is not entirely satisfied that the questionable "inflamed" appendix which he has just removed was enough to account for the patient's vague abdominal complaints.

Omental torsion with herniation of the twisted portion through the base of omentum, however, is rare. A careful perusal of the literature to date reveals no report of such a condition, and because of this fact it was thought advisable to report such an interesting and unusual finding at the operating table.

Torsion of the omentum may be defined as a longitudinal rotation of the body of the omentum upon its base, varying in the number of twists, and involving one or more portions at different levels along its axis or in its entirety; with reactions ranging from simple congestion to gangrene of the terminal portion, depending upon the degree of vascular obstruction and the time at which the operation is performed. According to Jeffries, the first description of torsion of the omentum was made by Marchettis, who, in 1851, described a case associated with an inguinal hernia. The earliest reports of pure, true, idiopathic or primary torsion not accompanied by any intra-abdominal pathology, were made by Eitel in 1899 and Baldwin and Syme in 1902.

Various classifications of torsion of the omentum have appeared in the literature, and we have modified the simple classification of Wallace and Miller, basing it on the associated lesion (if one is present), and the anatomical location of the omental mass. Torsion of the omentum may be divided into two main groups: primary and secondary.

(*A*) Primary (pure, true, idiopathic):
1. Simple torsion,
2. Torsion with herniation of torsion through omentum itself.

(*B*) Secondary:
1. Hernial,
2. Hernio-abdominal,
3. Abdominal,
4. Pelvic,
5. Combined.

The term "primary" should be applied only to cases not allied with any pathological process; e.g., hernia, abdominal or pelvic inflammation or malignancy, or congenital malformation. In all other cases the term "secondary" should be used. When the omentum is rolled into a ball and is either hanging free in the abdominal cavity or attached by fine adhesions (which are a result of the acute attack) to a neighboring organ, it is known as simple torsion. Torsion with herniation of the mass through the omentum itself is self-descriptive.

The subdivisions under the heading of "secondary" may be briefly described as (1) hernial, when the rotated omental mass is found in a hernial sac, whether adherent to it or free; (2) hernio-abdominal, when there are fibrous bands between the omentum and the hernial sac or the internal inguinal ring, but the rotated mass lies in the abdomen; (3) abdominal, when it is attached to any abdominal viscus or to an old laparotomy scar; (4) pelvic, when it is fixed to an organ or structure in the pelvis; (5) combined, when the tumefaction has more than one site of attachment. It is to be noted that primary torsion of the omentum may occur in the presence of an

old hernia and still not be associated with it.

There are many contentions regarding the etiology of omental torsion. Among those mentioned by various authors are congenital anomalies (pedicle formation, accessory omentum, omental bands); exaggeration of normal movements of the omentum; increased peristalsis; inflammation, hyperemia, thrombosis, and embolism of one of the large tortuous omental veins; and sudden changes in intra-abdominal pressure which may result from trauma to the abdominal wall or unusual physical exertion. We feel that a factor that is frequently overlooked is the anatomical characteristics of the omentum itself. It is made up of four layers of peritoneum and has no skeletal structure except for the vessels that ramify through it. The normal shape tends to be that of an irregular quadrilateral with the right border longer than the left. The length is variable and apparently depends more upon the age and less upon the sex of the individual, according to the deductions of Lockwood. His investigations of thirty-three cases revealed that in twenty of them below 45 years of age, only one subject had an omentum that could be drawn beyond the pubic tubercle, whereas above the age of 45 years, it was uncommon to find an omentum that could not be pulled beyond the lower borders of the peritoneal cavity. In the adipose individual the omentum is well infiltrated with fat. This has a tendency to increase the weight and also to elongate the omentum as well as the accessory omental projections usually found along its right border. The heavier and longer the omentum becomes, the greater is the tendency to pedicle formation. With the lengthening of its longitudinal axis or radius, the arc described or the area covered by its movements is increased, so that the chances to undergo rotation are enhanced. The distal portion of the normal omentum moves freely on its base. When a part of the terminal segment becomes adherent to a neighboring structure because of a healed or chronic inflammatory process (hernia, appendicitis, cholecystitis, scars of previous laparotomies) it becomes fixed at both ends producing an important factor in torsion. Because of the great mobility of the right border of the omentum and since the right side of the abdominal cavity presents the greater number of lesions, the twisted omentum is almost always found in the right iliac fossa although it may be situated in the right hypochondriac, lumbar or epigastric regions, depending upon the organ involved.

Torsion may occur at any age. According to elaborate statistics compiled by Morris from 217 cases in the literature, torsion occurs most frequently between the ages of 30 and 50, the oldest being 80 and the youngest 3 years of age—the average age being 45.3 years. It is more common in males (62.7 per cent) than in females, and the general nutrition of the individual is usually described as adipose. We have found that primary torsion occurred in about 15 per cent of the reported cases of torsion of the omentum. The commonest factor in the secondary type of torsion seems to be an old inguinal hernia, which may account for the occurrence predominating in males. When there is an associated hernia it is of the right inguinal type in 81.4 per cent, left in 12.3 per cent, and seldom with umbilical ventral or femoral hernia. The history in these cases is one of a hernia of many years duration, painless and easily reduceable, which suddenly becomes enlarged, painful and irreduceable, and a preoperative diagnosis of strangulated hernia is made.

The signs and symptoms are variable, depending on the site and degree of involvement. Before the onset of the illness, some patients may give a history of one or more previous attacks of vague generalized, mild abdominal pain or cramps, accompanied by eructation or nausea, that is usually complained of as "dyspepsia." This persists for twelve to twenty-four hours, leaving a feeling of soreness in the right lower quadrant or the para-umbilical region. The pains are cramp-like in nature,

moderate in severity, and do not radiate. They are aggravated by movement and tend to abate for a short time, only to recur

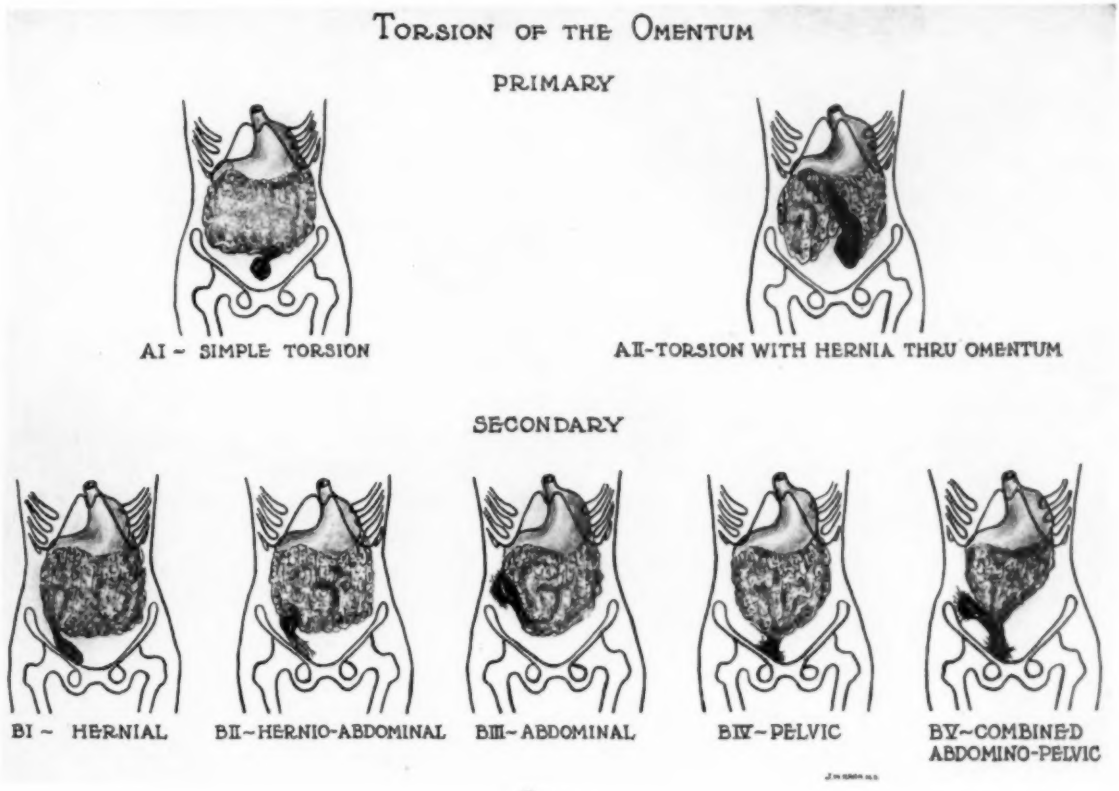


FIG. 1.

again. Nausea and vomiting are present but the latter is not as frequent as the former. Cathartics, which are usually taken although the bowels move normally, do not alter the pains. The patient does not appear very ill and as a rule the general condition does not mirror the abdominal catastrophe. The movements of the abdominal wall are restricted and respiration tends to be of the thoracic type. On physical examination there is tenderness and rigidity extending from the right iliac fossa to the right paraumbilical region, but when it is more generalized it usually indicates the involvement of a major portion of the omentum or spreading peritonitis. The elongated tumefaction which appears within twenty-four hours may be palpated as a rubbery doughy mass, if it has attained the proper size and if the rigidity and muscular spasm of the abdominal wall can be overcome. The abdomen is moderately distended. The temperature varies from 98°–100°, pulse 80–100 and respiration 20–24. The total white cell count ranges between 10,000 and 18,000 with a moderate polymorphonuclear leucocytosis.

At operation the peritoneum is noted to be edematous, and on entering the peritoneal cavity there is an escape of blood-tinged fluid. This exudate is a result of strangulation and at times there are evacuated more than 1½ liters of fluid, which as a rule is bacteriologically sterile. When extensive gangrene has taken place, a seropurulent fluid may be present. The twisted omentum may be hanging free in the abdominal cavity, or may be found adherent to the parietal peritoneum or adjacent viscus by fibrous strands of recent origin, which can easily be separated by a gentle wipe. In the secondary type the adhesions are thicker and stronger, and require cutting to separate the omentum from the site of attachment. The appearance of the mass

depends upon the time between the onset of the torsion and the time of operation, the pathology varying with the degree and duration of vascular obstruction. Macroscopically, during the early stages the compact edematous mass has a dark red hue which gradually changes to a bluish-black color, with greyish areas appearing in the peripheral portion indicating necrosis. With complete gangrene it may slough off at its pedicle and become an intra-abdominal loose tumor. Microscopic examination does not reveal any characteristic lesion. The findings are a polymorphonuclear infiltration and the usual tissue reactions as vascular congestion, thrombosis and necrosis. The number of twists have been stated as being from four to eight, although one case has been reported with the omentum twisted twenty times on its pedicle. The appendix is usually found to be normal except when it is intimately associated with the omental torsion.

The diagnosis of primary torsion of the omentum is seldom made pre-operatively, and when the diagnosis of torsion is made it is usually of the secondary type associated with an old inguinal hernia which suddenly begins to trouble the patient. The diagnoses that are frequently made before operation are strangulated hernia, acute appendicitis, perforated appendicitis with abscess formation, acute cholecystitis and partial intestinal obstruction. The differential diagnosis of these conditions may appear simple from the academic standpoint, but clinically it is quite difficult. Probably the outstanding characteristics that may lead to a correct diagnosis are to be found in a middle aged robust individual, complaining of pain in right lower quadrant of sudden onset, with an early appearance of an elongated abdominal mass, and whose general condition is slightly, if at all, altered.

The prognosis in torsion of the omentum is good if operated upon early. Although a pre-operative diagnosis is almost impossible, the life of the patient is not seriously affected because the erroneous diagnoses that are often made in this type of lesion require an immediate laparotomy in any event. The only difficulty that may arise is when the abdominal tumefaction is considered to be an appendiceal abscess and delayed treatment is instituted. In such cases the terminal event may be gangrene and suppuration with local or generalized peritonitis. Exposure to complications that follow laparotomies for other conditions are to be considered.

Early surgical intervention is the only method of treatment. A right rectus incision is made over the lesion and it is extensively liberated. Careful resection is performed in healthy tissue just proximal to the site of torsion. It is not advisable to just unwind the twisted mass and replace it in the abdominal cavity without extirpation, as there is a great tendency for the torsion to recur because of its previous altered anatomy. Drainage is usually not necessary.

## CASE REPORT*

S. S., 40 years old, male, shipping clerk, was admitted to the Israel Zion Hospital on March 10, 1935, complaining of upper abdominal pain of five days duration, the onset of which was sudden. The following day he had para-umbilical cramps, felt nauseous and developed a diarrhea which continued up to the time of admission, when the pain localized in the right lower quadrant and became more acute. There was no history of vomiting or previous attacks of a similar nature.

The patient was well developed and nourished and did not appear to be acutely ill. Physical examination was essentially negative except for moderated tenderness and rebound tenderness in the lower right quadrant. No organs or masses were palpable. Rectal examination was negative. Temperature 99.6, pulse 90, respiration 20, blood pressure 120/80, urine negative, total leucocyte count 9,800, polymorphonuclears 70 per cent, lymphocytes 28 per cent, mononuclears 2 per cent. A preoperative diagnosis of acute appendicitis was made and operation performed.

* From the surgical service of Drs. Linder and Wolfson.

A right gridiron incision was made and the structures constituting the anterior abdominal wall appeared to be moderately edematous. The peritoneum was opened and about one liter of sero-sanguinous fluid was removed from the abdominal cavity by suction. The appendix was located in the pelvis. Its wall was noted to be swollen and the serosa injected. On further exploration, the omentum was felt and observed to be situated in the right upper quadrant, knotted upon itself and producing a mass about the size of a fist. It was discolored, and at first examination it appeared to be walling off some perforated viscus. Because of this situation, an upper right rectus incision was made. The omentum showed evidence of marked venous stasis and the caliber of the dilated veins was almost equal to that of normal small intestines. The mass was carefully though easily liberated from all surrounding organs, and it was found that the omentum had twisted four times upon itself along its longitudinal axis and then had herniated through a rent in the omentum at the level of the gastrocolic ligament. The gall bladder, stomach, duodenum, large and small intestines revealed no pathology.

The strangulated portion of the omentum was resected serially in normal tissue, stumps ligated and the upper right rectus wound closed in layers. Through the original McBurney incision the appendix was removed without difficulty and stump inverted by purse string suture. One cigarette drain was placed in the pelvis and the wound closed in layers.

*Pathological Report.* Gross: Appendix is short and somewhat swollen. Measures 5 cm. in length and averages 8 mm. in diameter. Serosa deeply injected.

On section the lumen is very narrow, almost pin-point in size. Wall is markedly thickened, measuring 4–5 mm. in width.

There is a portion of omentum weighing about 100 grams. Surface shows irregular hemorrhagic areas. On sections there are many considerably engorged blood-filled blood vessels and irregular hemorrhages, here and there. No other abnormalities noted.

*Microscopical.* Appendix. No lumen is seen. The lymphoid tissue glands are missing—only remnants of round cells seen here and there with some areas of fibrosis. The serosa contains a number of congested, dilated vessels, some of them containing polymorphonuclears.

Section of omentum. Shows layers of fat, in which irregular hemorrhages and widely dilated blood-filled vessels are seen.

*Diagnosis.* Chronic obliterative appendicitis, with activity. Hemorrhage into omental fat with early infarction (in portion of omentum).

*Post-operative.* The post-operative course was uneventful except for the presence of acute bronchitis from the second to the fourth day. The patient was discharged improved on March 21, 1935, with the right upper rectus wound completely healed and the McBurney incision healed except at the site of drainage.

## SUMMARY

A case of omental torsion with herniation of the torsion through a rent of the omentum is presented. Etiological factors resulting in the rotation of the omentum, a classification, pathology, signs, symptoms, diagnosis and treatment are discussed.

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# HOMOGENOUS THIERSCH GRAFTING AS A LIFE SAVING MEASURE*

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EVER since Reverdin[1] in 1869, developed the method of skin grafting which has been known by his name, efforts have been made to increase the scope of the possible transference of tissue. Reverdin's grafts were autogenous grafts. Following this other surgeons tried transplanting skin from one individual to another. From that time controversy has raged as to whether or not the homo- or iso-grafts actually take—actually become a part of the new host. The literature is full of ridicule of the idea. McWilliams[2] says " . . . the result will most certainly be nil. I emphasize this point because . . . surgeons are tempted to try something that is almost certain to result in failure. Never have I had any success with iso-grafts. . . . The success of iso-grafts may be relegated to mythology. . . . We are compelled to maintain that all skin grafts should always be autogenous; i.e. should always be taken from the patient himself, and it would be an error ever to take skin from another individual, no matter how closely they are related even though the blood groupings are the same. . . . The futility of these procedures cannot be too strongly emphasized."

Padgett[3] states, "Homo-transplantation of tissues is only temporary. . . . For all practical purposes homo-transplantation of skin may be relegated to the realms of medical mythology."

Equally facetious is Graham:[4] "This study, of course, only supports what was well known before, that grafts from other persons do not grow. Nevertheless, it will probably still happen that some surgeons will use grafts of skin from kind hearted volunteers of the local fire department when little Mary is burned."

Padgett[5] laments, "Some quite competent surgeons pander to the wondering delight of a credulous laity, and mother, brother, and even friends, are encouraged to give up a part of their skin to some poor injured soul, but unkind fate as yet seems to have decreed that such a sacrificial offer on the altar of a sympathetic and generous martyrdom is doomed to failure; for both experimental and practical evidence indicates that iso-dermic skin grafting is not practical except possibly from identical twin to identical twin. . . . An immediate 'take' occurs in a majority of cases. In nonrelated individuals, about the third week the grafts begin to disappear, and by the end of the fifth week usually have disappeared. . . . The evidence seems to indicate that individual differences in homo-transplantations are shown by primary substances, given off by the graft which act as toxins and stimulate the cells of the host to a leukocytic and fibroblastic cellular reaction against the graft."

Blair and Brown[6] write that "Homoplastic grafts could be made to take but that in all cases after a few weeks the grafts sloughed away." As a matter of fact, very few surgeons report that the graft will permanently take.

Gillies[7] points out that homo-grafts of skin, as commonly transplanted, are for all practical purposes unsuccessful.

Trusler and Cogswell[8] agree that the homo-plastic skin graft is not successful.

Maddock[9] observes that "The skin to be grafted must be taken from the same

* Read before the Twenty-fifth Annual Meeting of the Alumni Association, University of Oregon Medical School, Portland, Oregon, March 8–10, 1937.

individual. Heterogenous grafts are practically always unsuccessful."

McWilliams[10] states, that "autografts are always chosen."

Fig. 1. Case 1. A. L. W., age 9 years, received an 80 per cent second and third degree burn of the head, face, neck, entire back, chest, abdomen, buttocks, thighs, legs, right arm, forearm and hand, left shoulder region. Photographs taken fourteen days after the burn show the wide extent of involvement. Primary treatment was tannic acid and silver nitrate, but was not kept dry.

Coller[11] deplores that "After many attempts at using iso-grafts, we are convinced of their futility and always use autografts. . . . There is either a sudden reaction causing an immediate disappearance of the graft or an apparent 'take' followed in several weeks by a loss of the graft by disintegration."

Holman[12] argues that, "Successful iso-grafts exist only in fable and not in fact." These judgments are endorsed by Lexer,[13] Freeman,[14] Perthes[15] and others. However, Davis,[16] Masson,[17] Shawan[18] and a few more claim that iso-grafts may remain permanently.

It is not the purpose of this paper to maintain that iso-grafts remain, for they surely do not. A point hitherto overlooked is to be discussed. In a study of the literature no statement was found which indicated the condition of the patients during the time that the grafts remained except that Holman[12] stresses the possibility of protein sensitization from the use of iso-grafts twice from a single donor. He points out that the first application is without danger, but that the patient may become sensitized to a second application from the same source.

In the literature one finds examples of iso-grafts from a number of donors, placed at the same or at different times. There is no sensitization and the grafts come away in much the order in which they were placed. The conclusion is that the anti-substance which removes a graft is specific for that particular graft.

It has been my experience that iso-grafts will remain in place for from two to five weeks, usually three to five, and that upon examination toward the end of this time they appear in good condition, but upon changing the dressing after another twenty-four to forty-eight hours, the grafts are gone and in their places is a moist, granular, flaky substance. This degeneration may involve only a few grafts at a time and the disintegration may continue for about two weeks, beginning usually about the end of the second or third week. By the

end of the fifth week usually all grafts have come away.

But what has been the condition of the patient during the time that the grafts have been in place? All authorities agree that iso-grafts take temporarily. It must be admitted then that the areas covered by the iso-grafts are healed for the time being and free from infection although the surrounding areas may still show infection.

Fig. 2. Same patient as in Figure 1, several days later, following the daily application of oxyquinoline sulphate scarlet R gauze. Areas were homogenous skin grafted and later autogenous grafted with recovery and without hypertrophied scars.

This is the important point: The areas covered by the homogenous grafts are healed for the time being and free from infection. The patient is rid of these areas of sepsis while the grafts have temporarily taken. This surely benefits the patient. There is less infection for the patient to handle. During the time that these grafts are in place and the infected area is lessened the patient in his depleted condition is better able to successfully combat the remaining infected areas. It is manifest, therefore, that the general condition of the patient must improve and it does. The temperature comes down a little, the pulse and respiration also are somewhat improved and the white blood cell count improves to a much greater degree. The greatest improvement is in the feeling of well-being, the increase in appetite and strength and also in the mental improvement which is shown by the increased interest which the patients take in their surroundings. The sepsis is markedly less by the time the grafts come away and the condition of the patient is surprisingly better. He may then be skin grafted from himself without danger from the operative procedure and with assurance that the grafts will take in a field which is much less infected, and in a patient who is much improved over what he was before the temporary grafts were placed. Two cases will be cited to demonstrate the value of temporary homogenous skin grafts.

Case 1. A. L. W., male, age 9 years, entered the Doernbecher Memorial Hospital of the University of Oregon Medical School twelve days following a second and third degree burn which covered 80 per cent of his body surface. The burn covered the entire body, except both feet and ankles, part of one leg, both axillae, small areas on the internal surface of the thighs and portions of the left arm. He was roasted, as in an oven, when the house in which he was trapped burned down. His early care was quite satisfactory. He was under treatment by tannic acid and silver nitrate[19,20] in less than fifteen minutes following the burn, and the primary critical period was safely weathered. Shock was combated from the

beginning and his early condition was very good. However, due to unsatisfactory drying of the surfaces the burned areas were moist and infected. It is important in the treatment of burns to keep the surface dry, but it is difficult to do, especially away from the facilities of a hospital, and particularly when the nurses are not properly impressed with the necessity for such drying.

Fig. 3. Case II. J. S., aged 7 years. Over 60 per cent second and third degree burn. Primary treatment was tannic acid and silver nitrate, but was not kept dry. Photographs taken thirty-three days after burn.

Upon entering the hospital where I first saw him, his temperature was 105.4, pulse 186 and the unhealed areas were covered with pus. The ulcerating surfaces were dressed with oxyquinoline sulphate scarlet R gauze[21]* to clean them up and promote healing. He was septic and did not do well. His condition was decidedly not good. The sepsis was progressing despite treatment. The laboratory gave a very gloomy prognosis, based on the presence of many vacuole and other young blood cells.

Thiersch grafts were thereupon taken from the anterior surfaces of both thighs of his father after matching the bloods and were placed on the unhealed areas. The dressing was the same as that used to prepare the areas for grafting, that is, oxyquinoline sulphate scarlet R gauze with dry gauze over. Up to this time his afternoon temperature had never been under 103.6. Shortly after the application of the homografts his temperature dropped to 102.8, and did not rise above this point throughout the remainder of his treatment, except on four occasions. The temperature curve was slowly but progressively downward. The pulse also showed a slowly declining curve.

The dressings were not changed for nine days. The grafts adhered about two weeks and by the time they came away his general condition had very greatly bettered. His mental outlook improved and he became interested in his surroundings and his appetite improved. He was decidedly less septic.

At this time, using a local anaesthetic, from 75 to 100 small Reverdin grafts were cut from the back of his left thigh and placed over the unhealed areas on the back, chest, abdomen, arms, buttocks and thighs. These grafts took very satisfactorily. His temperature and general condition from this time on improved very rapidly and in seven weeks more he was discharged in good physical condition with all areas entirely healed, the skin being soft and firm and remarkably free from hypertrophied scars.

Case II. J. S., female, age 7 years, entered the Portland Shriner's hospital for Crippled Children more than thirty days following a burn of over 60 per cent of her body surface. The early treatment, which consisted of the application of tannic acid and silver nitrate, was very satisfactory and tided her over the primary critical period. However, the surfaces had not been kept as dry as was desirable. The extensive unhealed wound was covered with free pus. She was extremely septic. Her temperature was 104 and the pulse 140, of poor quality. Her hemoglobin was 50 per cent and her white blood cell count 17,000 to 37,000.

* Oxyquinoline sulphate scarlet R gauze is made by immersing with mesh rolled bandages in the following ointment heated on a water bath.

| | | |
|---|---|---|
| ℞. Oxyquinoline sulphate | grains | 10 |
| Trichlorbutanol (chloretone) | grains | 40 |
| Scarlet R Biebrich's medicinal | grains | 96 |
| Oleum Ricini (castor oil) | ounces | 4 |

When Biebrich's Scarlet R is not available, five per cent scarlet R ointment may be used in place of it and the castor oil.

Her condition was decidedly poor. Very little hope was held out for her recovery.

The suppurating areas were dressed every second day with oxyquinoline sulphate scarlet R gauze and improved from dressing to dressing. The fight between her resistance and the sepsis was a losing one. Something had to be done at once to lessen the septic absorption. Thiersch grafts were therefore cut from the anterior and lateral surfaces of both thighs of her Mother, after typing the bloods. Between 105 and 110 square inches were removed. These grafts were placed over the unhealed areas on the right arm, right chest, front and back, abdomen, both thighs, and both buttocks. The dressings consisted of oxyquinoline sulphate scarlet R gauze with dry gauze over it. These were not changed for nine days. Her temperature, pulse and respiration improved slowly following the application of the grafts, but the white blood count dropped on the third day from 22,400 to 8,600 and her appetite and general condition improved greatly. There was a remarkable change in her mental condition especially loss of apathy. This was noted particularly in her desire, sick as she was, to take part in the hospital Halloween party. Although over 60 per cent of her body surface was a healing wound, at her request she was moved from her private room into the ward where she could watch the fun and she participated, even to the extent of joining in the singing.

FIG. 4. Same patient as in Figure 3, showing involvement of the left portion of the body. Applications of oxyquinoline sulphate scarlet R gauze were made to prepare area for skin grafting.

FIG. 5. Same patient as in Figures 2 and 3, showing involvement of the anterior surface. She received over 105 square inches of homogenous Thiersch grafts from her mother, and five weeks later 225 Reverdin grafts from herself.

At the end of nine days the dressings were changed and then every second day. All grafts took. Careful watch was kept to determine when they were coming away. The grafts began to disappear about the end of the third week and by the fifth week all were gone.

At this time, 225 small Reverdin grafts were cut from her own left thigh and were placed on the unhealed areas. Oxyquinoline sulphate scarlet R gauze dressings were again used and

were not changed for another nine days, then every second day as before. All grafts took and her general condition continued to improve from day to day so that after fourteen weeks in the hospital, she was discharged with all areas entirely healed. All skin areas are smooth and flexible and look like normal skin. There is a notable absence of those thick contracted hypertrophied scars so frequently seen.

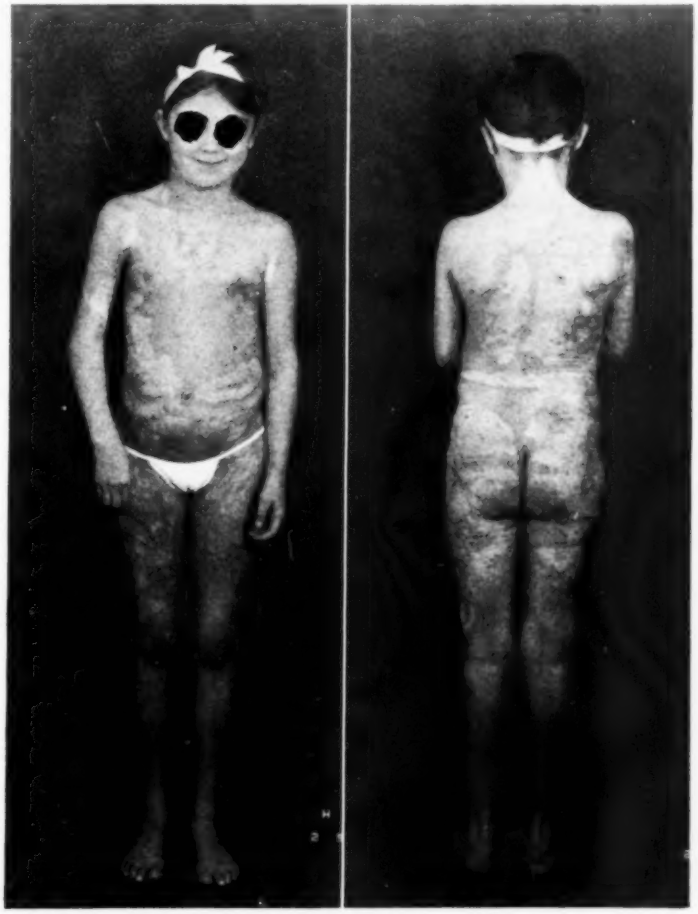

Fig. 6. Fig. 7.

Fig. 6. Same patient, showing complete healing without hypertrophied scars fourteen weeks after the burn.

Fig. 7. View of back. There is absence of deformity. All skin is soft and pliable.

It might be well to review the technique by which the Thiersch grafts were handled. They may be cut with any suitable razor. The one which was used was made from a Durham-Duplex razor[22] from which the serrations on the left side had been removed. The only advantage in this razor is that it is always at hand and is always sharp, and when the edge begins to become dull a new sharp blade is inserted. The graft may be cut as wide as over two inches and as long as desirable.

Some difficulty is frequently met with in holding the skin of the extremity while the grafts are being cut. Many methods have been tried and the one which has been found most valuable is by the use of two vacuum cups connected to a single vacuum pump by a Y tube. Instead of pressing down against the uneven surfaces of the underlying muscles, the skin is pulled up and lies smooth. One cup is held up by an assistant as counter pressure while the second is drawn ahead, just in advance, of the cutting razor. It is advisable to cover the surface with a thin layer of petrolatum before starting to cut the grafts.

The area to which the grafts are to be applied is prepared by the daily application of oxyquinoline sulphate scarlet R gauze, the same dressings being used after the Thiersch grafts are placed and finally being covered by four to eight layers of sterile gauze held firmly on by bandages and adhesive plaster. These dressings are not changed for nine days, even though there is some soiling, unless there are special indications for so doing. After the first dressing they are changed every second day. Autografts as well as homogenous grafts are dressed in the same manner.

When this technique is carried out, it will be noted that the skin heals in a remarkably smooth manner. Instead of a thin, red glazed shiny surface covered with dilated superficial blood vessels, one finds skin which very closely resembles normal skin, usually without the disfiguring island effect so frequently seen, especially after Reverdin grafting.

## CONCLUSIONS

There is general recognition of the fact that homogenous grafts do not take permanently. The present paper points out that during the three to five weeks that the grafts are adherent, the covered area is cleared of infection and the patient therefore is saved the disastrous effects of septic absorption from those areas. The outstanding point is that by the time the grafts come away the patient's condition is so greatly improved that measures which were not to be thought of earlier may now be carried out with safety.

This plea for the use of homogenous Thiersch grafts is brought to you because it has proved efficacious to patients who otherwise must have succumbed to their sepsis. It is truly a life-saving measure.

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# NEW INSTRUMENTS

## FRACTURES OF THE TARSAL BONES*

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THE treatment of fractures of the tarsal bones has been attended with a marked degree of permanent disability.

It may be of interest to describe an entirely different method of treating these injuries and present a representative case showing the results of such treatment.

It may be presumptive to assert that one has developed a different idea, an entirely different plan of treatment from what has been accepted and followed for two thousand years. Experience now extending over many years justifies me in making this claim.

My work has rested upon the development of a type of splint equipment that has made it possible to utilize in a systematic way mechanical powers combined with a conservation of physiological activities that are unapproached in the literature.

The splints are based upon the primary principle that distention between supports amply and properly distributed upon the adjacent bone structures will be sufficient to overcome shortening and bring the bone ends into apposition and practical alinement. There is a definite plan of procedure to bring any remaining lateral deformity to fine correction.

For each fracture the correct design of splint is assembled to apply these powers. The splint is applied first with the minimum of disturbance of the fractured area; now the limb is stabilized and the operation of the splint controls the movement of the fragments back through their path of egress. There is no erratic movement. It is a smooth sliding of the fracture back to normal.

There is no pain in the fractured area and no need for an anesthetic, local or general.

These statements are made with full recognition that they are in marked contrast to the hand manipulations, many of which add additional trauma to an already severely damaged structure. The inefficiency of these hand manipulations has prompted recourse to operative procedures, which impose many hazards of their own.

The splint equipment for all splintable fractures is composed of a standard assortment of pieces that can be assembled at the bedside to form any conceivable design that might be required. The finished splint fits each patient like a tailor-made suit of clothes.

Splints for fractures of the long bones operate upon the principle of making distention between proper supports upon the bone structures above and below the fracture. Descriptions of these splints with clinical results have been published.

For fractures of the tarsal bones, the purpose of this presentation, there is a bone support above, but none below, the fracture. The necessity then is to build an ample and rigid support upon the limb above the fracture, and from this support exercise the necessary corrective measures.

For a minor deformity in a patient with poorly developed soft tissues, an unpadded cast applied to the skin smoothly without tension, from the muscular insertion of the tendo Achilles up to and against the heads

* Presented before the Northern Medical Association, May 17, 1937.

of the tibia and fibula and the patella, may be sufficient. Where greater support is needed and more pressure is to be exercised,

The splint arms, four in all, are attached to the projecting metal ends on the leg cast and to the side strips on the ankle

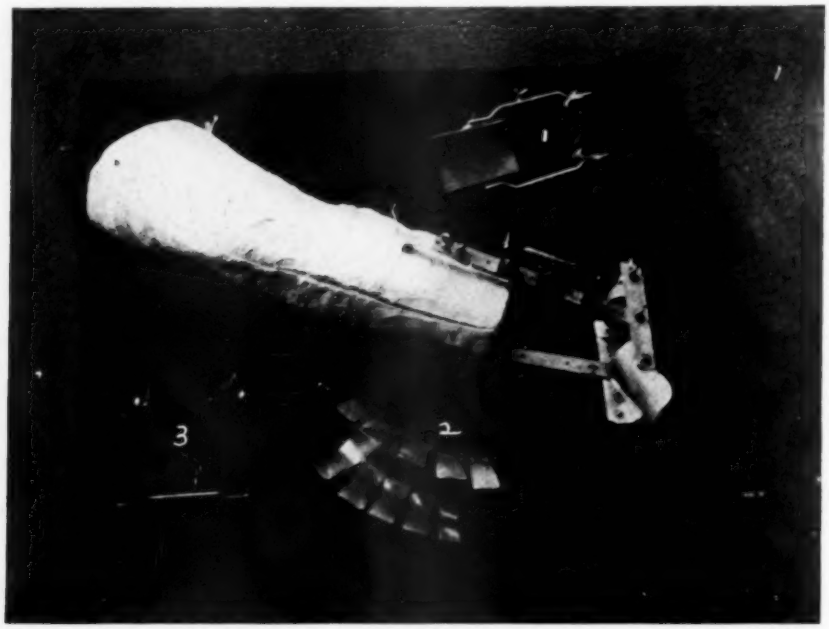


FIG. 1. (1) The ankle bracelet shows the side arms flared out for excess swelling. (2) The arch plate can be trimmed with stout scissors and shaped to suit. (3) The compression clamp is a powerful instrument for lateral displacements not corrected by linear distention.

the cast should extend over the flexed knee and upon the thigh. Here the brace is against the posterior length of the femur as well as against the contours of the flexed knee. The cast should not be molded into the popliteal space but should span between the hamstring tendons. The flexed knee prevents any possibility of rotation of the splint.

Metal plates with projecting ends are imbedded on both sides of the leg cast. These projecting ends point to the maleoli on both sides respectively.

The ankle bracelet is now adjusted to the foot. This is composed of a heel stirrup to engage the top of the heel and a curved plate for the dorsum of the foot. Both are padded with cushion rubber. These two parts are connected along the sides by metal strips that have a series of holes so that the stirrup and dorsal plate can be adjusted to any size of foot except a quite young child.

bracelet respectively. They should project toward each other on both sides and be of sufficient length to have an ample overlap. The lower splint arms should run inside of the upper arms for the more convenient attachment of the turnbuckles later. These overlapping arms are enclosed in a sleeve with a thumb screw that can be turned to clamp the overlapping arms together.

The turnbuckle brackets are now screwed to appropriate holes in the overlapping arms for the insertion of the closed turnbuckle. The clampable sleeves should lie between the brackets.

The splint is now ready for the distention. The parts are stabilized by the splint. The slide of the fractured bones is without false movement, being controlled by the splint. The splint arms are swivelled to the ankle bracelet so that the dorsal plate or the heel stirrup moves under distention in the line of least resistance. The fracture being in the calcaneum usually,

the heel stirrup presses forward, the dorsal plate maintaining a relatively fixed position. The effect of this is to restore the arch

Fig. 2. A. J., 67 years old. Right foot. Comminuted fractures of the astragalus and the os calcis. Moderate upward displacement. *X*-ray taken December 25, 1936.

of the foot. The turnbuckle screws can be operated to correct version or turned up evenly to maintain the alinement. The distention is continued until the patient gives complaint of considerable pressure. I have found this degree of distention ample to bring the bones into practically normal position.

Should there be lateral displacement of the bone, distention is first performed and then my compression clamp is applied to force the bones together. An arch plate with upturned sides that can be bent in to make the requisite lateral pressure is applied and held up with adhesive plaster to the connecting strips of the ankle bracelet.

With the correction secured, the distention pressure is *let down immediately* to perfect comfort. This means just a snug

Fig. 3. A. J., 67 years old. Right foot. Firm bone union in practically normal position. *X*-ray taken April 19, 1937.

rest of the splint against the parts to prevent slipping back.

A few thoughts concerning walking irons for fractured tarsal bones. I consider it unwise enthusiasm to permit walking on walking irons before some callus is deposited. I prefer early return to work rather than early hobbling on walking irons. In a leg cast including the foot, whether the patient bears weight on the foot or on walking irons, the major portion of the weight is borne by the foot, a most unwise procedure.

Whenever walking irons are used, the weight-bearing should be transmitted to the leg above the fracture. Walking irons are attachable at any time to the side splint arms of my splint. They may be

used after the ankle bracket is removed for protection against indiscretion or for weight bearing.

Fig. 4. A. J. Left foot. Comminuted fracture of the os calcis with marked upward displacement. *X*-ray taken December 25, 1936.

Fig. 5. A. J. Left foot. Firm bone union in practically normal position. *X*-ray taken April 19, 1937.

The following rather interesting case demonstrates the capacity of this method of treatment.

A. J. 67 years old, carpenter, dropped in a mill elevator from the fourth floor to the basement. He was taken to the Northeastern Hospital. The *x*-rays disclosed a comminuted fracture of the astragalus and the os calcis of the right foot with moderate upward displacement of the os calcis. The left foot showed a comminuted fracture of the os calcis with marked upward displacement. There was no lateral displacement. Evidently there had been rupture of large vessels in both feet. The parts were engorged with blood to three times normal dimensions. The skin was black and distended, seemingly ready to burst.

The splints were applied as previously described. Distention was made to the point of marked pressure discomfort. This was done with some trepidation because of the severe trauma. It was the less of two evils. The heel stirrups made deep indentations over the swollen heels. With the accomplishment of the distention, and the apparent visual restoration of the arches, the turnbuckles were let down until there was no discomfort. Even so, the stirrups remained deep in their grooves over the heels. The compression clamp and the arch plates previously described were not needed.[1]

The sleeves were clamped, holding the overlapping arms in fixed position, and the turnbuckles were removed. There was no pain in the fractured area during reduction. This is my

[1] This accident occurred on the afternoon of December 24, when an immediate *x*-ray could not be taken and the amount of injury to the bones could not be determined. Splints were applied and full manual distention was exercised, and on the next day, after the *x*-rays were taken, the turnbuckles were used. Any correction of the original deformity by the manual traction is conjectural.

usual experience. There was no need for any anesthetic, either general or local.

The parts were watched for serious injury. None occurred.

The foot splints were removed on the twenty-third day and replaced with walking irons. These were for protection and not for walking. (After this period of time the bones will remain in position, barring some indiscretion.) The ankle joints were mobile. The patient moved his ankles voluntarily from the beginning.

Pictures taken 105 days after injury show firm union with fracture lines obliterated, and both feet with practically normal arches. He is walking with minor discomfort doubtless due to ligamentary weakness which I anticipate will disappear.

"Vomiting is a prominent feature of arteriomesenteric obstruction and dehydration and dechlorination are likely to attend it. The diagnosis is made by the finding on *x*-ray examination of a dilated duodenum."

"After trivial trauma, in uremia, diabetes and other conditions, acute gastric dilatation may occur with unaccountably little provocation."

"Bands causing intestinal obstruction usually concern the small intestine; when the large intestine is involved, the flexures of the colon are usually implicated—the hepatic, splenic and sigmoid flexures."
From—"The Therapeutic Problem in Bowel Obstructions," by Owen H. Wangensteen (Thomas).

# THE LOWSLEY-PETERSON UNIVERSAL ENDOSCOPE*

## A NEW INSTRUMENT AND ITS USES

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NEW YORK CITY

THERE is hardly an endoscopic problem which cannot be met with someone of the endoscopes available. The old Brown-Buerger cysto-urethroscope can be used for procedures ranging from bilateral renal pelvic lavage to simultaneous catheterization of both ejaculatory ducts. It may take considerable time and patience, but it can be done.

Most endoscopes have direct vision, while a few have foroblique optical systems. The older ones have no telescopes, since they are of the so-called "dry" type. Very few have any provision for the introduction of catheters or electrodes, and these few are of such restricted use as to be specific (for instance, McCarthy's instrument for the catheterization of the ejaculatory ducts).

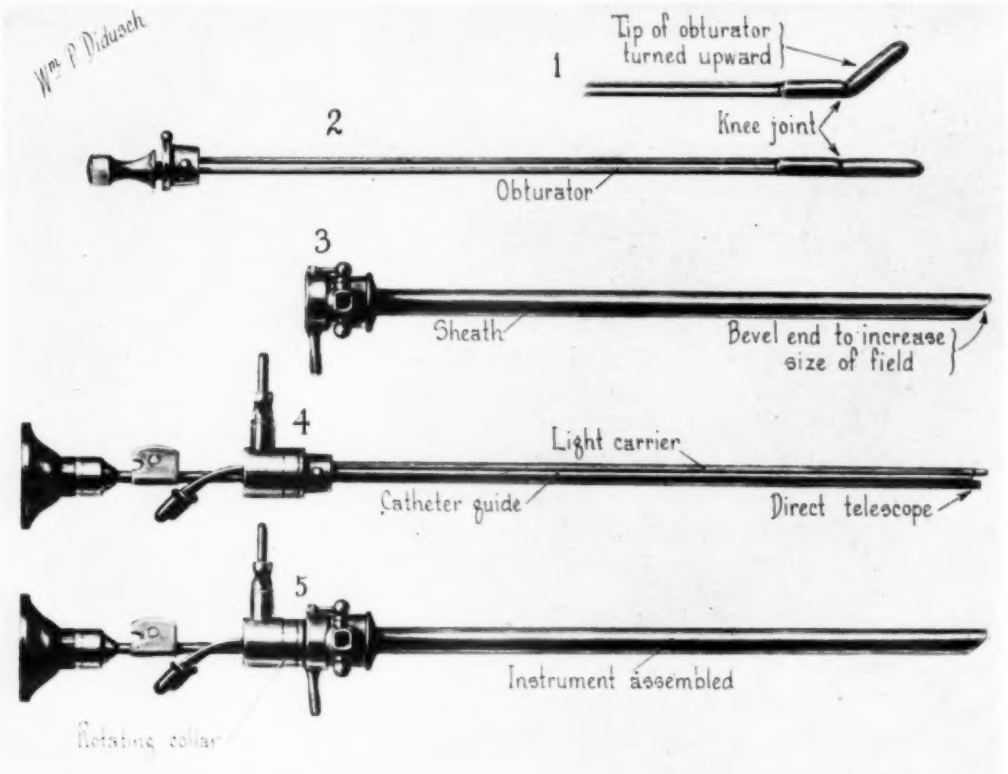


FIG. 1. Obturator is placed in sheath and its tip deflected by turning the knurled knob of its handle. The instrument is then passed into the bladder and inverted as one would pass and invert a concave cystoscope for the examination of the trigone. The obturator is then straightened and withdrawn; light and water connections are made. The sheath should be permitted to fill with water before the telescopic unit is inserted. Before insertion, the telescope should be adjusted so that a small sector of the sheath remains visible at from 10 to 2 o'clock, with the cable connecting post at 6 o'clock.

Experience in over 1500 endoscopies with the most commonly used instruments, such as the Brown-Buerger cysto-urethroscope, the McCarthy panendoscope and ejaculatory duct catheterizing instrument,

* Read before the New York Academy of Medicine, Section on Urology, November 18, 1936.

and the Lowsley urethroscope, gave us the desire to design an endoscope, incorporating the best features of these instruments of catheters and electrodes. The head of the instrument should have a locking device that is easily operated and reliable.

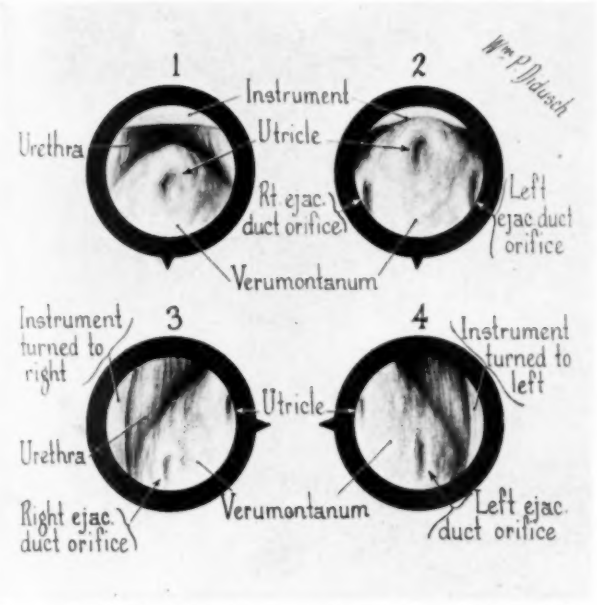


Fig. 2. With the flow of water adjusted to a light trickle, the instrument is slowly withdrawn from the bladder and observation of the vesical neck and posterior urethra made during the withdrawal. As the veru appears in the fenestra (1) the ocular end of the endoscope is raised and slightly advanced until the visible sector of the sheath is placed over and behind the veru (2). The flow of water necessary for the distention of the urethra can now be shut off completely. By turning the telescopic unit to the right (3) or left (4) the lateral portions of the veru may be examined.

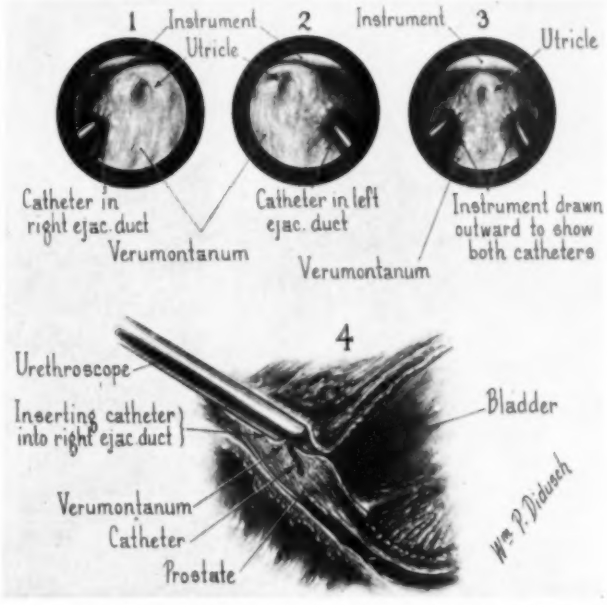


Fig. 3. Catheterization of ducts located on the frontal aspect of the veru. The telescope is loosened and retracted until the light bulb and guides become visible. The catheter is then fed in until it nears the veru. Rotation of the telescopic unit, with or without torsion of the catheter, will give the proper direction to the catheter tip for entering the ejaculatory orifice to be catheterized. Further passage should be made slowly and by short stages until 3 to 5 cm. have been passed. For technical reasons it is advisable to catheterize one duct at a time. Bilateral work needs exactness and precision that is not easily acquired.

and permitting the use of a new idea, i.e., having the entire assembly of telescope, light-carrier and guides rotatable within the sheath.

Our experience showed direct vision to be the most practical, since it permits visualization of the entire circumference of the urethra and the urethral aspect of the vesical neck at one glance and without rotation of the instrument. The rotation of any instrument in an even slightly inflamed posterior urethra causes bleeding and makes proper observation difficult or impossible.

The telescope should be independent of the light-carrier, allowing for necessary adjustments. Tubular guides are needed for the introduction and precise application The obturator should be deflectable and permit fixation in the deflected position.

The new instrument described here incorporates all these features. The obturator (1 and 2 of Fig. 1) is of the deflectable beak type, the position of the beak being controlled by the knurled knob of the handle. The sheath (3 of Fig. 1) is of 24 Charrière caliber, round and beveled at its distal end to increase the size of the field and provide a canopy for the verumontanum. The telescope is of the direct vision type and adjustable in position. The light-carrier and catheter guides form one unit with the telescope (4 of Fig. 1), and the entire assembly can be rotated in the sheath by means of a collar. (5 of Fig. 1.)

Two tubular guides of F 5 capacity run along the light-carrier. The external end of the guides is long and sufficiently curved to keep the catheters away from the examiner's face. The internal ends are shorter than the light-carrier and are not provided with special deflectors, the direction of the catheters being given by the pointing and the position of the instrument.

The handling of the endoscope for the observation of the verumontanum is illustrated in Figure 2. The various positions of the instrument for the catheterization of ejaculatory ducts opening on the frontal, lateral or upper aspects of the verumontanum are clearly shown in Figures 3, 4 and 5.

Although the instrument has been designed for posterior urethral work, particularly for the catheterization of the ejaculatory ducts, it will give good service in anterior urethroscopy, including the coagulation of infected glands, fulguration of polyps in the posterior urethra and on the bladder floor, and unilateral or bilateral ureteral catheterization and renal pelvic lavage.

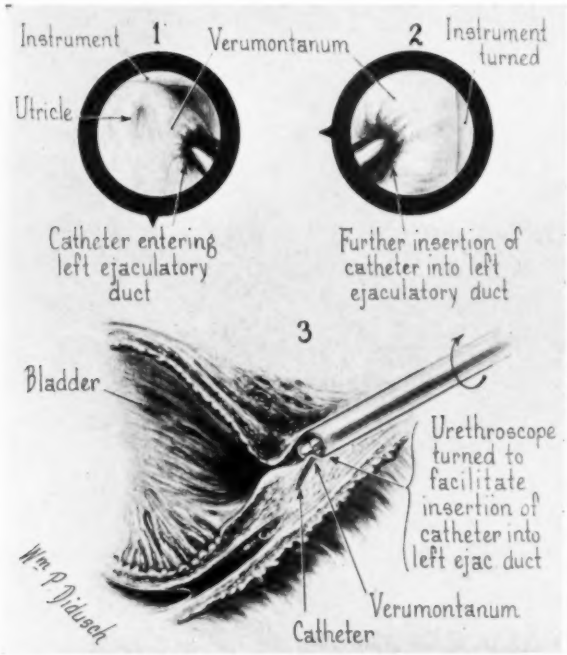


FIG. 4. Catheterization of duct opening on the side of the veru. The tip of the catheter is engaged from the left side and passed for 2 to 3 mm. The cable post is then rotated clockwise until the catheter appears to be pointing towards the vesical neck, before further passage is effected.

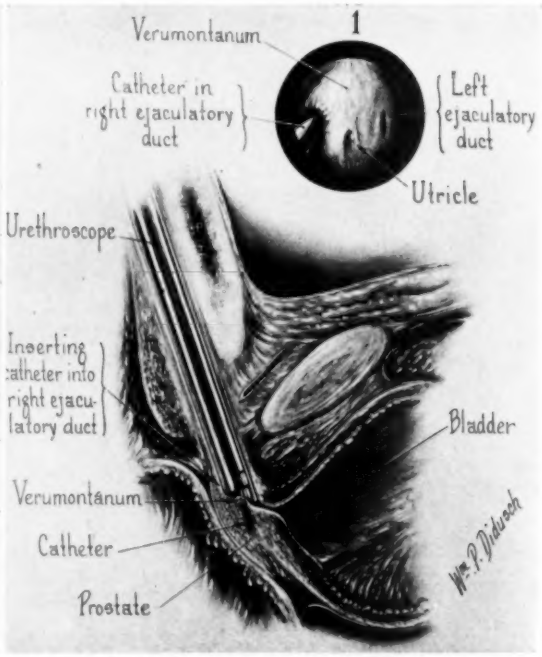


FIG. 5. Catheterization of ducts located on the top of the veru. The ocular end of the endoscope is raised until the bevel of the fenestra is flush with the floor of the posterior urethra, and one appears to be looking down on the verumontanum. Rotation of the telescopic unit will bring the posterior aspect of the veru, the two sides and its front into the field of vision, as desired. Retraction of the telescope will permit observation of the entire veru and insertion and passage of the catheter with a facility not to be obtained with any other instrument.

# INSTRUMENT FOR PINCH GRAFTING

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USUALLY pinch grafts are picked up with the aid of a needle held in a clamp. The objections to the needle and clamp are two-fold. (1) The needle tends to rotate in the clamp; and (2) there is difficulty in picking and holding a graft when one is working on a lateral surface, particularly so when one gets close to the surface of the table.

Recollections of a sharp hooked instrument with which the dentist probes around teeth resulted in the trial of a dental explorer for picking up grafts. (Fig. 1.) It facilitates pinch grafting if an explorer is used. The hooked end works best, although the curved end can be used. The points are highly tempered and can be touched up on a stone whenever necessary.

FIG. 1. Dental explorer.

# A PORTABLE SITZ BATH*

CECIL D. GASTON, M.D., F.A.C.S. AND W. Q. MOORE

Chief of Proctology, Hillman Hospital, South Highlands Infirmary

President, American Cast Iron Pipe Co.

BIRMINGHAM, ALABAMA

THE Gaston-Acipco bath meets the demand for a safe and effective bath, with application of heat, in the post-operative care of rectal cases, and is also useful in genitourinary and pelvic conditions. During the immediate post-operative care of rectal cases, employment of the hot sitz bath is indispensable. The unit here described enables the hospital to render a prime and proved aid to rectal patients.

FIG. 1. Size of the bath compared to that of an average-sized adult.

The use of the conventional bathtub in these cases is not without danger. One of us (C. D. G.) has seen two distressing results of the use of a bathtub for hot sitz baths; in one instance there was fracture

* Read at the Thirty-eighth Annual Session of the American Proctologic Society, Atlantic City, N. J., June 7, 1937.

FIG. 2. The ease in getting in and out of the bath is apparent. Note that the body weight is transferred to the hand hold while the patient's feet remain on the floor. The positive mechanical foot-brake on the rear wheel has secured the tub.

of a femur, and, in another, strangling followed collapse while in the bath.

The portable sitz bath shown in Figures 1, 2 and 3 was created through four years of experimentation and clinical application by the authors. Its distinctive features are safety, comfort, simplicity, cleanliness, easy and noiseless conveyance to the patient's bedside, permanent construction, and effective operation. The tub is shaped to provide quick and complete drainage, and its surfaces are easily cleaned. The usual service room is ample for storage.

The bath is prepared in the service room or in the patient's room. Approximately 1½ to 3 gallons of hot water are required, according to the patient's displacement. The temperature of the water is varied to suit each individual's tolerance, in most cases approximately 110 to 120 degrees F. A partially inflated rubber tube, covered by a smoothly folded bath towel is placed in the tub. The patient takes his position in the bath and is draped with a sheet or blanket depending on the temperature of the room. The temperature of the water remains practically constant during the bath. During the immediate period following rectal surgery, this bath should be used three times daily and after each bowel evacuation, the patient remaining in the tub 15 to 20 minutes.

FIG. 3. The patient is at ease in the bath. The feet are resting comfortably on adjustable rests.

[From Fernelius' Universa Medicina, Geneva, 1679.]

# BOOKSHELF BROWSING

## MEDICINE ONE HUNDRED YEARS AGO*

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"A THOUSAND years in Thy sight are but as yesterday when it is passed and as a watch in the night" says the Psalmist. How short then is a century? Against the background of man's evolution, no more perhaps than a small part of a watch in the night. One hundred years is not so long, though much in medicine has come to pass in the last hundred years. To roughly gauge how much, may I turn back for you the pages of time to 1837? In this year appeared the twentieth volume of the oldest monthly medical journal in the United States and one of the oldest in the world, the *American Journal of the Medical Sciences*. In looking through this volume one should be able to catch something of the spirit of the times, identify the leaders in medical thought, and learn something of what they were thinking. The editor was Isaac Hays, Surgeon to the Wills Hospital in Philadelphia. The publishers were Carey, Lea and Blanchard.

Opposite the title page is a list of "collaborators," a list containing many names familiar in American medicine. At the head stands Elisha Bartlett, M.D., "the Rhode Island Philosopher" of Osler, at that particular stage of his wanderings titled Professor of Pathological Anatomy in the Berkshire Medical Institution, that Pittsfield school made real to the friends of Dr. Frank E. West, as the scene of his story of the skeleton in the river. We next come to Jacob Bigelow, who with Ware and John C. Warren represent Harvard University, unmistakable spokes from the "Hub of the Universe."

Pennsylvania of course is here in force: Nathaniel Chapman, co-founder with Carey of the journal, first known as the *Philadelphia Journal of the Medical and Physical Sciences* (1820), Dewees, "late Professor of Midwifery," William Gibson, the surgeon, Horner, the anatomist, Samuel Jackson of the chair of Medicine, and Philip Syng Physick, pupil of John Hunter and still venerated as one of Pennsylvania's great men. Philadelphia was also represented by half a dozen collaborators without teaching positions, the best known of whom was W. W. Gerhard, of Blockley, later to occupy a chair at the University, who first clearly differentiated typhoid and typhus fever. Indeed, from that day to this our Philadelphia brethren seem to have been more than a little touched with

* Read before the Section on History of Medicine, Medical Society of the County of Kings, Jan. 29, 1936.

*pruritus scribendi*, and, be it said, to the decided advantage of the rest of us.

The College of Physicians and Surgeons of New York contributes but one name, that of Valentine Mott, Professor of Pathological (sic) and Operative Surgery, and familiar in feature to those who often go to Hosack Hall at the New York Academy of Medicine.

Other medical schools flourishing at the time and mentioned in the list were the Medical Colleges of the State of North Carolina, of Louisiana, of South Carolina, Georgia, and Maryland, Rutgers Medical College in New York, Geneva College, Dartmouth and Columbian College in Washington.

Turning from the journal's front to the pages of original contributions, we find them opened with a brief account—two pages and a half—by Valentine Mott, describing one of his brilliant feats in vascular surgery, ligation of the internal iliac artery. This paper is cited in Garrison's History of Medicine.

Next comes an illustrated case report from the pen of a Naval Surgeon, Thomas Harris, on Macroglossia, cured by operation. Dr. Reynelle Costes, of Philadelphia, contributes a long and very sensible discussion on the current methods of treating fractures of the extremities.

"Remarks on the Sandwich Islands" is an extremely interesting paper by a returned medical missionary, Dr. Alonzo Chapin. This was within sixty years of the landing of Captain Cooke (1779) and the writer found the natives pretty thoroughly riddled with syphilis, which he was able to check in some instances by the use of mercury. He had some difficulty explaining the absence of malaria in spite of the presence of "thousands of acres entirely converted into ponds of standing water." There is some discussion of undifferentiated fevers and catarrhs and of a mild form of rheumatism, attributed by him to the lack of proper shelter and the natives' amphibious habits. The people were given to the use of powerful and drastic cathartics, resulting, in his opinion, in serious bowel disturbances. There is some further description of the "ridiculous and dangerous" medical practices of the natives. The possibilities of the islands as a health resort are considered, and there is an account of the somewhat limited cultural resources, including preaching twice on every Sabbath. "Of the sources of gayety and dissipation, I have nothing to say."

Following a report of round worms in the bladder, comes an article from the Friends Asylum near Frankford, by Drs. Charles Evans and R. R. Porter. There are six carefully presented case reports of "moral insanity," three patients being discharged cured and three dying, autopsies being performed in all the fatal cases. The authors emphasize the relation of the physical state to mental derangement, and the importance of recognizing and treating such faults as anemia and digestive disturbances.

There is a remarkable report covering the case of a negress whose child died in utero, and one month later was delivered through the abdominal parietes, the uterine wall having become adherent anteriorly and sloughed through. The paper is by Dr. S. H. Harris, of Clarksville, Virginia, and deserves some quotation. "The medical profession" he says, "has been deprived of many useful facts by the negligence of country practitioners in not reporting rare and extraordinary cases, many of which come under their observation, and are soon forgotten or resigned to the gossips of the neighborhood, to swell the catalogue of traditionary wonders." Again, in describing the conduct of her labor, so long futile—"that sympathy which never yet slumbered about the bed of travail, was particularly active on this occasion. Nothing indeed was left untried, which benevolence or zeal could suggest, to alleviate her sufferings or inspire her with courage."

The original articles of the first number—the journal was a quarterly and two numbers constitute a volume—end with an account of an extensive brain injury

cured by venisection and purgation, and a long, scholarly and somewhat confused article on Spinal Irritation and Inflammation by Samuel Annen of Baltimore.

The journal is next occupied to the extent of eighty-nine pages in Book Reviews and Bibliographical Notices. As today, each review is signed by the initials of the reviewer. Some of them are twenty pages long, epitomizing much of the argument and adding editorial comment. There is a long review of a French text book on psychiatry (Ferrus). "The Nature and Treatment of Dropsy" by E. J. Seymour of London is considered at length. The heart, the liver, the arteries, the peritoneum, receive the most attention and though but eight years after Bright's paper, the kidneys are recognized as a frequent cause of edema. Books on Calculous Disease (Benjamin W. Dudley), and on Consumption, on Cancer, on Creosote, and so on, from the French, German, and English are reviewed. Of special note was Bowditch's translation of Louis on "Typhoid Fever." It will be recalled that Louis was the outstanding clinician of his time, from whose clinic in Paris such men as Holmes, Jackson, Gerhard, Warren and Bowditch returned to America filled with enthusiasm for the type of medicine they had been taught.

Much of interest pertaining to our subject could be learned from a perusal of the sixty odd pages constituting the "Quarterly Periscope," reviewing advances in all fields of medicine. Included are reviews of papers on anatomy by Purkinje and by Schwann, a paper on experimental physiology by Sir Astley Cooper, several papers by Andrew Buchanan on iodin and hydriodic acid, papers by Schoenlein, by Magendie, and by many other less eminent luminaries. Much space is given to a serious epidemic of influenza in London. It sounds familiar.

We have covered the first of the two quarterly issues included in the volume. The leaves of the second must remain unturned, except to note that they include the second of Gerhard's two classical papers in which he clearly separated typhus and typhoid fevers. Surely, enough has been presented to show that much was happening in medical development one hundred years ago. The American view was sampled by turning back just one century, and the volume brought to light contained two papers of sufficient importance to be recorded in Garrison's History of Medicine. It reflected a lively interest in the current contributions of eminent European medical pathfinders, and finally it recorded the work of lesser, but honest and industrious American practitioners, eager for improvement and ready to share the results of their labors with the profession. May 1937 provide as fine a record.

# THE FORGOTTEN MAN, SAMUEL GUTHRIE*

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IN the midst of the wilderness in the extremely northern part of the State of New York, without any of the facilities of modern science, chloroform was discovered by a pioneer, backwood's chemist and physician. Early in the year 1831, Dr. Samuel Guthrie, who at the time was residing in Sackett's Harbor, New York, devised an easy method for its preparation. He described his discovery in an article which he entitled a "New Mode of Preparing a Spirituous Solution of Chloric Ether," and he forwarded it to the editor of the American Journal of Science. This article, wherein he outlined in detail his method of preparation, was published in October, 1831.

A few months later, in January, 1832, Soubeiran of France published a paper in a French journal of chemistry and physics, setting forth his own method of making chloroform, which he had formulated in the latter part of 1831. He named his product bichloric of ether, giving it the formula CHCl.

Still another claimant for the discovery appeared in the person of Justus Liebig of Germany, who published his account in November, 1831, six months after Dr. Guthrie's manuscript was in the publisher's hands and one month after its publication. Liebig called it chloride of carbon and gave it the formula $CH_4Cl_5$. However it has been definitely proven that Dr. Guthrie was the first to publish an account of the discovery.

Dr. D. B. Smith, in an article appearing in the Journal of the College of Pharmacy in 1832, made the following report after analyzing the preparation supplied by Dr. Guthrie: "There can be no doubt that the liquid first made by Dr. Guthrie was fairly pure chloroform." On the other hand, Dr. Jean Dumas, working in Paris in 1834, examined the liquid prepared by Soubeiran and declared that it contained many impurities. He also found that Liebig had made an error in stating its composition. Dumas was the first man to name the liquid chloroform, and he worked out its true formula $CHCl_3$, using the present system of atomic weights.

Samuel Guthrie was born in Brimfield, Mass., in 1782. Very little is known about his boyhood days and his preliminary education. His father was a physician and he served his apprenticeship in medicine in his father's office, doing all the necessary work as a doctor's assistant and occasionally reading some texts on medicine. When he felt that he had acquired enough knowledge and training to strike out for himself, he settled in Sherburne, New York, where his grandfather was living, and in the course of time married Sybil Sexton. During the winter of 1810–1811 he attended courses in the College of Physicians and Surgeons, New York, and during January, 1813, he heard some lectures at the University of Pennsylvania. Apparently, he held no diploma from any medical school, and he received a very inadequate medical training.

In 1817, he moved to Sackett's Harbor, New York, near the Canadian border. His medical practice did not attain such proportions as to occupy all his time, so he busied himself with other pursuits. Being mechanically inclined, he repaired guns and fashioned various copper implements. He opened a vinegar house, where he distilled a brand of alcohol highly praised

* Read before the Section on History of Medicine, Medical Society of the County of Kings, Jan. 29, 1936.

and well patronized by the neighboring farmers. His active mind was directed toward scientific research in his chemical laboratory, where he invented and started to manufacture priming powder to fire guns and cannons. In 1831, he sent six contributions to the *American Journal of Science*, which was edited by Professor Benjamin Silliman of Yale University. His experiments covered a variety of subjects as the following titles indicate:

"Vaporization of Mercury in the Fumes of Nitric Ether,"

"Making Sugar from Potato Starch,"

"Fulminating Preparations,"

"Purification of the Oil of Turpentine,"

"A New Process for Manufacturing Gun-powder,"

"A New Mode of Preparing a Spirituous Solution of Chloric Ether"—his major experimental work. He also called this preparation sweet whiskey.

In one of his letters to Dr. Silliman, Dr. Guthrie described the hazardous circumstances under which some of his experiments were performed. The chemical reactions in numerous instances took place with great suddenness and violence with the result that the doctor sustained numerous body injuries. His worst experience, encountered when some percussion powder he was working with took fire and exploded, left him with severely burned arms and with breast, neck, and face from which the skin had been torn off. He gave himself credit for about one hundred explosions.

After 1831–1832, Guthrie's experimental work fell off, and no articles describing new products or processes came from his pen. Apparently, frequent and violent explosions dampened his spirit of research; more probably, he started to exploit commercially some of the preparations he had already developed.

In 1847, James Young Simpson disclosed to the world the anesthetic effects of chloroform. In this connection, it is interesting to note the following comments included in a letter written by Dr. Guthrie to his eldest daughter in 1848, a few months before his death:

"I could have made a fortune if I had gone to New York as I was urged last fall by making sweet whiskey. . . . You see it called Chloroform and the newspapers are beginning to give me credit of discovering it. . . . This is likely to prove the grandest discovery in medicine the world ever saw. By breathing it a few seconds the person falls apparently into a sweet sleep . . . when breasts, legs and arms may be cut away . . . painful labors ended, and all without pain and injury."

On October 19, 1848, at the age of 66, Dr. Guthrie passed away, practically unknown. The house which he occupied in Sackett's Harbor for thirty years still stands; but no tablet commemorating his wonderful discovery ornaments it. The late John B. Murphy, the well-known Chicago surgeon, inaugurated a movement and the Chicago Medical Society appointed a committee to further it, to place an appropriate tablet, delineating the facts of Dr. Guthrie's discovery, on a large boulder brought to Chicago by the latter's grandson, Ossian. The response to the movement was very poor and it died in committee.

So lies the backwoods chemist and physician, buried in an obscure grave in the cemetery of Sackett's Harbor—no monument, no tablet, not even a photograph to perpetuate the memory of one of the greatest benefactors of mankind . . . the discoverer of chloroform.

# SURGICAL PROBLEMS

*This department, for which the answers have been prepared by competent authorities, is maintained for the benefit of our subscribers. All queries must contain the name and address of the writer. Names will not be published.*

*Question:* I have a patient who for the fourth time aborted spontaneously at about the third or fourth month. Repeated examinations have disclosed no apparent cause for this and I am at a loss to know what to do. The family is extremely anxious for a child.

*Answer:* Such cases of habitual abortion are not unusual. There has been considerable experimental work within the past decade to show that many such instances are based on dietary deficiencies, particularly hypovitaminosis, or upon hypothyroidism or endocrine imbalance between the pituitary and the ovary. The treatment, which must attempt to correct such disturbances or deficiencies, may be carried out as follows:

1. Even though the history does not suggest syphilis, that disease must be carefully excluded. A single negative Wassermann reaction cannot be accepted; a provocative test should be done. In some instances a course of antiluetic therapy is successful even in the absence of any sign of syphilis. It is not recommended until all other measures have failed.

2. A well-balanced diet, high in mineral and vitamin content, should be insisted upon, with special attention to the use of cod-liver oil or its derivatives. Such a diet should include a preponderance of green vegetables, fruits, and at least a quart of milk a day. A deficiency of vitamin E may cause habitual abortion, and since the vitamin E content of an ordinary diet is difficult to estimate, it may be advisable to administer additional amounts in the form of wheat germ oil.

3. Hypothyroidism may be responsible for habitual abortion. If present, it calls for the use of thyroid extract and iodine. The basal metabolic rate should indicate the deficiency before medication is used. The dose of thyroid extract may be regulated by following the pulse rate and basal metabolic rate of the patient.

4. It has been recently demonstrated that the corpus luteum hormone, progesterone, is not only necessary for preparation of the endometrium for successful nidation, but also required for the prevention of excessive muscular activity of the uterus. The hormone is especially indicated in the treatment of habitual abortion and has been used by several physicians with considerable success. It is given in doses of 1 c.c. (one rabbit unit) two to three times a week until the fetus is viable. Other similar preparations, known as progestin, proluton, and corlutin, have essentially the same action.

*Question:* How may one be reasonably certain that the membranes in a pregnant woman have ruptured? I have had some difficulty in the past in deciding this fact. Occasionally the incontinence of a little urine is taken by the patient to be a loss of amniotic fluid.

*Answer:* Amniotic fluid is a pale, clear fluid with a slightly alkaline reaction. Its characteristic odor may aid in its recognition, while the appearance of the cheese-like vernix caseosa is conclusive evidence of rupture of the membranes. In doubtful cases, where a history of loss of fluid is present, but examination shows no fluid, the fetal head may be blocking the site of rupture of the membranes. In such patients digitally pushing the head upwards during rectal or vaginal examination is commonly followed by a gush of amniotic fluid. Many obstetricians employ indicators, since the normal vaginal secretion is slightly acid. Sterile litmus paper is of some value and may be used, but the best indicator is brom-thymol-blue. The method of procedure is to prepare applicators that have been dipped into a solu-

tion of the indicator and then autoclaved. These may be kept in a sterile jar and used as needed. Alkalinity changes the color from orange to bluish-green, which indicates rupture of the membranes. The test is of greatest value when used soon after the supposed rupture of the membranes. Occasionally blood may give a false positive.

*Question:* A white woman 58 years of age, previously in good health, has noted gradual loss of weight and strength for the past year. Within the past three months she has suffered from a foul-smelling vaginal discharge. Her menopause occurred fourteen years ago and there has been no bleeding since. Examination revealed a profuse foul-smelling vaginal discharge coming from the cervix; the latter was otherwise normal. The size and shape of the uterus were difficult to make out, due to the obesity of the patient and probably also because of incomplete retroversion. A diagnosis of pyometria was made and a curettage attempted. On dilating the cervix a large quantity of purulent fluid poured out of the cervix and I hesitated to go ahead. Culture of the exudate showed *Bacillus coli*. What should be the subsequent treatment of this patient?

*Answer:* The probable diagnosis in this case is carcinoma of the uterus, either of the fundal or the stenosing endocervical type. The immediate treatment should be adequately to drain the uterus and as far as possible to clear up the infection. A second dilatation of the cervix may be done and a rubber tube (about 20–24 F. size) inserted to avoid a return of the stenosis. The tube may be sutured with a single catgut suture to the portio vaginalis of the cervix to prevent its expulsion. It is inadvisable and dangerous to curette a uterus of this type at this time. Irrigation of the uterine cavity may be done with *B. coli* bacteriophage, or a 5 to 10 per cent solution of urea in sterile distilled water. Dakin's solution has also been used for this purpose. No pressure except that of gravity may be used in the introduction of the fluid for irrigation. The irrigating syringe may safely be held about 18 inches above the level of the uterus.

When the temperature, pulse, sedimentation time, and decrease of drainage indicate subsidence of the infection, a gentle curettage with a dull curette may be undertaken for diagnosis. A diagnosis of cancer calls for the intra-uterine application of radium. The risk of spreading the pelvic infection must be considered prior to the radiation and the optimum time chosen for the application. Deep *x*-ray therapy or total hysterectomy six weeks after the radium treatment represent the choice in the further treatment of the patient. This may be decided by consideration of the type and extent of the cancer, and the operative risk entailed in your particular patient. An endocervical cancer, parametrial extension of a fundal carcinoma, and great operative risk are contraindications to operation.

# BOOK REVIEWS

THE MANAGEMENT OF FRACTURES, DISLOCATIONS, AND SPRAINS. By John Albert Key, B.S., M.D., and H. Earle Conwell, M.D., F.A.C.S. Second edition. St. Louis, 1937. C. V. Mosby Company. Price, $12.50.

The first edition of this work was written for the student, the general practitioner, and the surgeon, and its purpose was to furnish a practical working guide in the management of fractures, dislocations, and sprains. Inasmuch as the treatment of so many injuries of this character is influenced by the Workmen's Compensation Laws, the authors have included a chapter on this subject.

In this second edition the authors have incorporated those additions and changes in methods of diagnosing and treating fractures which, since the publication of the first edition, they have found beneficial and which they believe to be sufficiently important and well tested to warrant publication in a textbook. In addition, every chapter has been carefully reviewed and many changes and numerous substitutions have been made. Dr. Edgar F. Fincher has revised Dr. Dowman's chapter on Skull Fractures and Brain Trauma, and Dr. James Barrett Brown has revised his own chapter on Fractures of the Face and Jaws.

Part I of the book deals with principles and general aspects; Part II with diagnosis and treatment of specific injuries. The subject is covered in detail and all the contributing authors write well. The book is 1246 pages long, has 1222 illustrations, and an ample index. It lives up to the promises made by the authors and remains in every sense a textbook for the student, general practitioner and surgeon. A sane, worthwhile work.

A TEXTBOOK OF THE PRACTICE OF MEDICINE. By Various Authors. Edited by Frederick W. Price, M.D., F.R.C.P., F.R.S. Fifth Edition. New York: Oxford University Press, 1937. Price $12.50.

When a physician inquires concerning three or four good standard textbooks on medicine he can be directed to purchase a copy of this work with the assurance that he will acquire one of the best works offered the profession. For a book does not appear in a fifth edition and many printings without good reason, and the principal reason is usually that many physicians have found it scientifically sound, well written, and up-to-date. In every detail this holds true of this, the latest, edition of a well-known work, which has during the past fifteen years been one of the leaders in its field.

The new edition has been thoroughly revised and brought down to the present. The editor has attempted, and successfully, to present a comprehensive and authoritative Textbook of the Practice of Medicine, and has included sections on Diseases of the Skin, Psychological Medicine, and also Tropical Diseases.

Each author is well qualified to write on the subject allotted him, and, as a whole, the volume covers its field in a practical manner, giving especial prominence to diagnosis, prognosis, and treatment.

The book is 2038 pages long, has 112 illustrations, and an ample index.

EVERYDAY FIRST AID. By Walter Frank Cobb, M.D. New York: D. Appleton-Century Company, 1937. Price $1.50.

This short (269 pages, 25 illustrations), practical book may honestly be recommended by the physician to his friends and patients. There are many "first aid" books, but Dr. Cobb has written his from an unique angle. At the beginning of each chapter he has given a news report of an actual case. Then, he proceeds to give a lesson in what to do and how to do it. The line drawings are well chosen to illustrate each lesson.

The author uses the word AID as a key, showing that the letters stand for what to do in emergencies: "Ask—Inspect—Do."

This is an excellent book on its subject and should have a wide distribution.

POST-GRADUATE SURGERY, Edited by Rodney Maingot, F.R.C.S. (Eng.). Volume III, with 1015 Figures in the Text. New York, 1937. D. Appleton-Century Company. Three volumes, priced, $45.00

This is the last of the three volumes covering the broad field of post-graduate surgery. In all,

the books run to 5,584 pages. We have already reviewed the two preceding volumes and found them of a high order of merit.

In this, the last volume, the following subjects are covered: Medical Aspects of Surgery, Hernia, Plastic Surgery, Obstetric Surgery, Cardiovascular Surgery, Lymphatic System (ten chapters are devoted to this subject), Orthopedics, Eye, Ear, Nose, Endoscopic Methods in Surgery, Malignant Tumors of the Pharynx and Larynx, Tonsils and Adenoids and Retropharyngeal Abscess, Tongue, Mouth and Lips, Esophagus and Diaphragm, Mandible, Fractures of the Mandible, Teeth, Venereal Disease, Physical Medicine, Deep *X*-ray Therapy, Some Aspects of General Surgery (eight chapters), and Some Neurological and Psychiatric Aspects of Surgery. The authors are all men of solid worth and reputation.

There is an Index at the end of each Volume covering the subject matter contained in it.

This is a large and bulky work. It might well be called an "encyclopedia" of surgery. The general format is pleasing to the eye, and the type is especially easy to read. The illustrations are well done. We sincerely hope the publishers will be rewarded for their courage in bringing out such a monumental work; their part in this enterprise is worthy of praise.

THE PRACTITIONER'S LIBRARY OF MEDICINE AND SURGERY. Volume XII—Preventive Medicine and Hygiene. New York, 1937. D. Appleton-Century Company. Price $10.00 (sold only as a set).

George Blumer, M.D., of Yale University School of Medicine, has acted as supervising editor, and Ira V. Hiscock, M.A., C.P.H., as associate editor of these volumes.

Although one cannot go into detail in reviewing a work which covers so large a field, suffice it to say that all the authors represented are well known to American medicine and are authorities in their special fields. Therefore, each chapter is scientifically sound and beyond criticism.

A list of the chapter headings, will enable the reader to judge of the scope and worth of this volume. The chapters cover: Periodic Health Examination, Content and Technique of Periodic Health Examinations, Hygiene of Nutrition, Clothing, Exercise and Rest, Excretion, Air, Sunshine and Cleanliness, Sex Hygiene, Personal Mental Hygiene, Hygiene of the Home, of Educational Institutions, Occupational Hygiene, General Sanitation, Air and Health, Protection of Water Supplies, Protection of Bathing Places, Sewage Disposal, Protection of Milk Supplies, of Foods and Drugs, Insects and Disease, Control of Communicable Diseases, Control of Tuberculosis, of Syphilis and Gonorrhea, Maternity and Child Hygiene, Adult Hygiene, Public Health Education, Public Health Organization and Budget, Infections, Intoxicants, Physical Agents, Deficiency Diseases, Prevention of Allergic Diseases, Prevention of Endocrine Disorders, of Heart Disease, of Respiratory Diseases, of Metabolic Disorders, Diseases of the Locomotor System, Prevention of Diseases of the Urinary Tract, of the Degenerative Diseases, and of Diseases of the Nervous System.

The book is 994 pages long, is illustrated, has references at the end of each chapter, and a good Index.

This book is worthy to stand with the other volumes of the set, and also could well stand alone, in the front rank, with the best works so far published on this valuable and broad subject.

# PRACTICAL CLINICAL GYNECOLOGY

HENRY C. FALK, M.D., F.A.C.S.

## NINTH INSTALLMENT

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## Chapter XIV

# OFFICE GYNECOLOGY

### ENDOCERVICITIS

The majority of gynecological patients who present themselves for office treatment are suffering from some form or complication of endocervicitis. In order to understand the pathology of the cervix a clear conception of its anatomy and histology is necessary.

The cervix is divided into two parts: the cervical canal, or endocervical portion, and the portio vaginalis, or vaginal portion. The canal is roughly fusiform in shape and is lined throughout by epithelium with racemose glands. There is a sharp line of demarcation between the epithelium of the cervical canal and the epithelium of the uterine cavity. This demarcation takes place at the internal os of the cervix. The epithelium lining the cervical canal is a high columnar epithelium with basal nuclei and a clear cytoplasm. At the external os, the glandular epithelium of the canal ceases and the stratified squamous epithelium of the portio vaginalis begins. (Fig. 173.) There is no gradual transition from the columnar epithelium of the cervical canal to the stratified squamous epithelium of the portio vaginalis.

The glands of the cervical canal secrete a thick tenacious mucus which forms a plug for the cervical canal. Some authorities claim that this mucus plug mechanically prevents gonococci and other organisms from entering the uterine cavity. It is true that the cervical plug acts as a mechanical barrier between the vagina and the uterine cavity, but one cannot help but feel that there must be some other agent which prevents the ascent of organisms through the uterus to the tubes and thereby to the peritoneum; this is thought by some to be an inherent function of the normal uterine cavity.

*Bacteriology of the Vagina, Cervix and Uterus.* The normal reaction of the vaginal secretion is slightly acid due to the

presence of lactic acid formed by the breaking down of the glycogen of the desquamated vaginal epithelium. The Doederlein bacillus, lactic acid, etc. are the main factors in maintaining

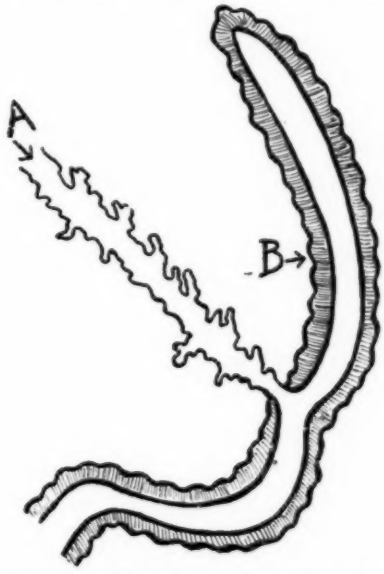


FIG. 173. Diagrammatic representation of A, the cervical canal; B, the portio vaginalis, showing sharp line of demarcation at the external os between the glandular epithelium of the canal and the stratified squamous epithelium of the portio vaginalis.

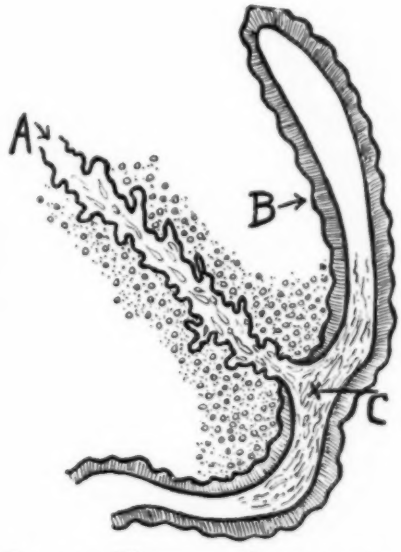


FIG. 174. Diagrammatic representation of the cervix, showing inflammatory reaction and round-celled infiltration in the tissues. A, cervical canal. B, portio vaginalis. C, marked increase in muco-pus from the cervical canal.

the bacteriological cleanliness of the vagina. The bacteriological cleanliness of the vagina may be judged by the number of Doederlein bacilli present. The pathogenicity of the vaginal secretion is in direct proportion to the increase in the number of other organisms present (cocci and bacilli). The cervical canal is sterile of pathogenic organisms until sex trauma takes place. It is at this time that streptococci, staphylococci, and occasionally gonococci enter the cervix. The uterine cavity is sterile except post partum, postabortal or following instrumentation.

What happens when the cervical canal becomes infected with gonococci or other organisms?

The infection extends rapidly upward along the glands to the internal os. The organisms enter the tissue and there is a

marked inflammatory reaction and cellular infiltration around the glands. The infection may extend deeper into the tissues and downward towards the portio, causing a subepithelial

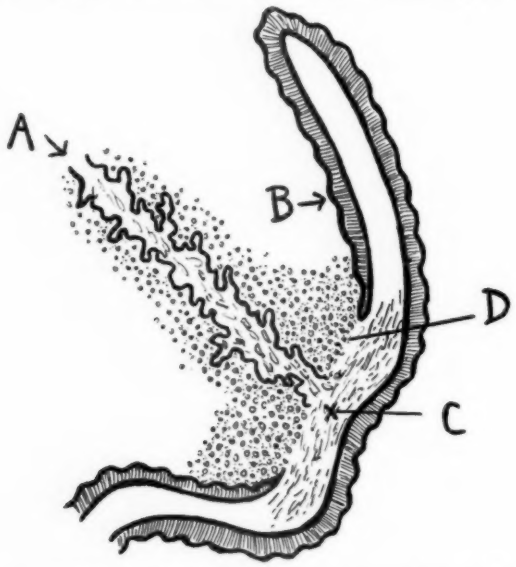


FIG. 175. State of true erosion. Diagrammatic representation of the cervix. A, cervical canal. B, portio vaginalis. C, cervical muco-pus. D, disappearance of stratified squamous epithelium around external os.

round-celled infiltration under the squamous epithelium. (Fig. 174.) Occasionally the infection may cause small subepithelial hemorrhages. As a result of this inflammatory reaction in and around the glands there is an outpouring of pus and mucus into the cervical canal. This flows into the vault of the vagina. In the normal anteflexed position of the uterus, the cervix (external os) is in constant contact with the posterior vaginal wall (see page 207); thus the pus pouring out of the cervical canal and lodging in this cul-de-sac constantly bathes the portio vaginalis of the cervix. As a result, the stratified squamous epithelium of the portio, which normally lives in a slightly acid medium, is bathed by alkaline pus from the cervical canal. This causes the epithelium to become soggy and swollen. Besides this external irritation, there is also present, as a result of the infection in the cervix (cervicitis), a round-celled infiltration, and occasionally small hemorrhages under the epithelium of the portio.

Owing to the combined action of these two irritants, vaginal and subepithelial, it is but a matter of time before the epithelium of the portio vaginalis immediately surrounding the

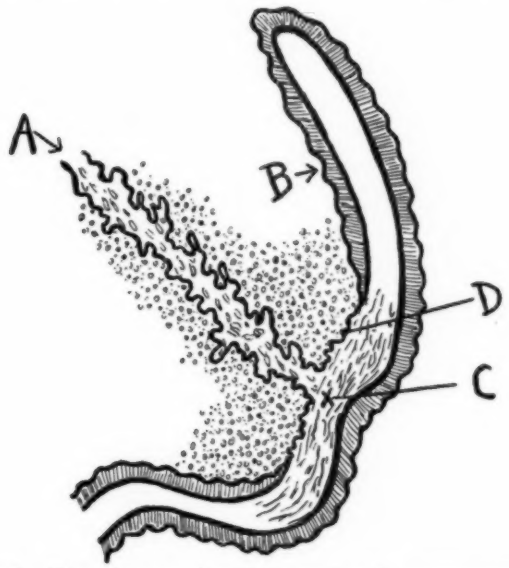


FIG. 176. First stage healing of an erosion. Diagrammatic representation of the cervix. A, cervical canal. B, portio vaginalis. C, cervical muco-pus. D, down-growth of glandular epithelium of the cervical canal to cover the raw area.

external os, disappears. *This raw surface is a true erosion and it is the only state of true erosion to exist; it lasts but a very short time.* (Fig. 175.) Nature does not allow a raw surface to exist for any length of time without making an effort to epithelialize it. As the stratified squamous epithelium of the portio cannot live in this infected medium and as the epithelium of the cervical glands is apparently more resistant to this infection and can live in this pus, it grows downward and covers this raw surface. This down-growth of columnar epithelium is spoken of as the *first stage of healing of an erosion.* (Fig. 176.)

Clinically, examination of the cervix at this stage shows a bright red area immediately surrounding the external os. It has a soft, velvety feel and there is usually a plug of muco-pus in the cervical canal. This bright red area which appears to be a raw surface and which is clinically called an erosion is in reality covered by a single layer of columnar epithelium.

When the cervicitis begins to improve, there is a diminution in the amount of discharge from the cervical canal and the secretion in the vaginal vault again becomes acid. As a result,

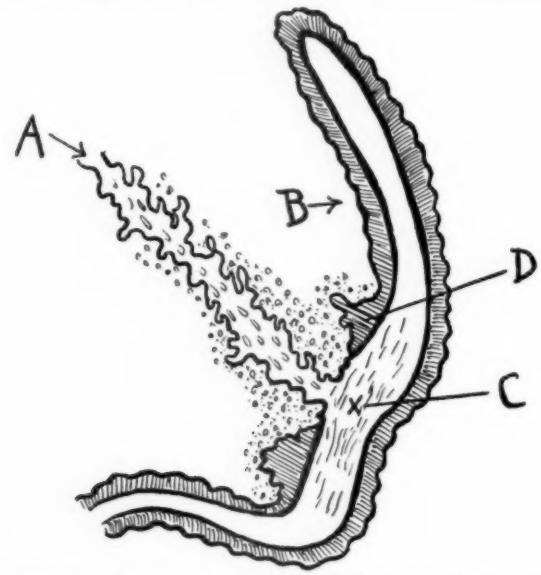


FIG. 177. Second stage healing of an erosion. Diagrammatic representation of the cervix. A, cervical canal. B, portio vaginalis. C, muco-pus. D, stratified squamous epithelium growing under the glandular epithelium and displacing it.

the glandular epithelium which covers the erosion and which normally lives in an alkaline medium, is now being exposed to the acid reaction of the vagina. Because of these frequent changes in reaction of the vaginal vault, there is a constant battle going on at the outer edge of the erosion between the glandular epithelium of the cervical canal and the stratified squamous epithelium of the portio. When the squamous epithelium has the upper hand it grows inward, underneath the glandular epithelium. This undergrowth of stratified squamous epithelium, displacing the glandular epithelium is spoken of as the *second stage healing of an erosion.* (Fig. 177.)

When the glandular epithelium has disappeared and the entire area is again covered by stratified squamous epithelium, it is called *the third stage of healing of an erosion, or cure.* (Fig. 178.)

With this pathological concept of an erosion, what should be done to cure the condition? First, clear up the infection in the cervical canal, thereby diminishing the discharge; second,

destroy the glandular epithelium covering the erosion so as to allow the stratified squamous epithelium to grow in and cover the raw area; third, prevent reinfection.

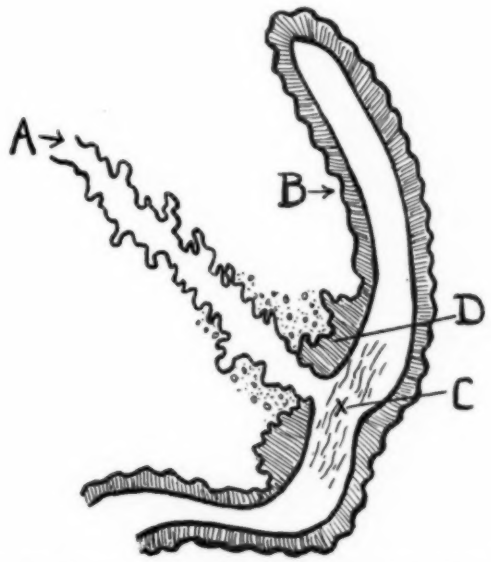


FIG. 178. Third stage healing or cure of an erosion. Diagrammatic representation of the cervix. A, cervical canal. B, portio vaginalis. C, diminution in muco-pus. D, stratified squamous epithelium has completely displaced the glandular epithelium, thus curing the erosion.

*Surgically* there is no better procedure than the Sturmdorf operation. When this operation is performed according to the Sturmdorf technique, all the glandular tissue of the cervical canal up to the internal os is removed. This raw surface is then covered with the mucous membrane of the portio vaginalis. Thus the infection is cured, the secretion from the canal disappears and the erosion is excised. However, most cervical erosions do not require surgery, but can be cured by office treatments.

*Medical or Office Management of Cervical Erosions.* The office procedures that are used to cure a cervical erosion attempt to bring about the same results that are obtained in the surgical treatment, i.e., (1) to cure the infection, thereby diminishing the secretion of the cervical canal; and (2) to remove or destroy the local lesion. However, instead of doing this at one sitting, it is done "bit by bit." For this purpose

several methods may be used, depending upon the desires of the operator: (1) the chemical method or injection treatment; (2) the thermal method or the nasal tip cautery; (3) the electrical method, coagulation of the lesion or excision by the radio knife.

Before any method of treatment can be carried out on the cervix or the cervical canal it is necessary first to cleanse the structures; under a good light the vaginal vault is wiped dry and the cervical canal is thoroughly cleansed. The mucus plug is usually very tenacious and difficult to remove. To remove this plug, a small piece of one inch gauze bandage, dry, dipped into tincture of green soap, caroid powder, or in a saturated solution of sodium carbonate and peroxide of hydrogen, equal parts, is introduced into the cervical canal with a dressing forceps and rotated. This acts much better than a cotton applicator, as the mucus seems to get caught in the meshes of the gauze.

*Chemical Method or the Injection Treatment.* Armamentarium—(1) 3 cc. Luer-lok syringe; (2) metal extension such as is used in tonsil work; (3) 1 inch, 25 gauge needle to lock on the extension. After thorough cleansing of the vaginal vault and the cervical canal, the cervix is painted with a 2 per cent aqueous solution of mercurochrome. It is grasped with a tenaculum forceps. The needle, using the extension and the syringe as a handle, is inserted into the cervical tissue, parallel and fairly close to the cervical canal. A few drops of solution are injected at the extremity of the puncture and the injection is continued as the needle is withdrawn. From ½ to ¾ of 1 c.c. of the drug is injected with each puncture. The first treatment is made at the four points of the compass, subsequent treatments are made between the points previously injected. Treatments are usually given at seven day intervals. Halvestine and Farmer recommend 2 per cent mercurochrome; Gellhorn uses a 1 per cent solution of methylene blue in normal saline. In the Endocervicitis Clinic at the Harlem Hospital a 2 per cent mercurochrome solution was used in 100 consecutive cases with fair results.

*Thermal or Nasal Tip Cautery Method.* Armamentarium: (1) transformer or rheostat; (2) nasal tip electrode and handle.

Transformer or Rheostat. The electrical current for use

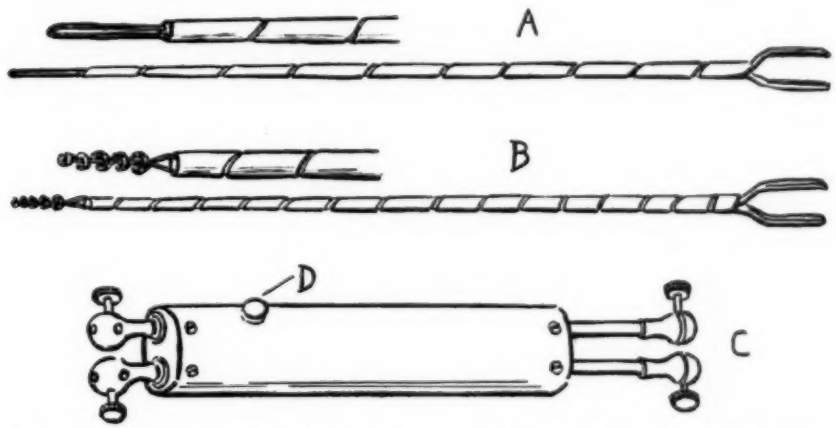


FIG. 179.—Electrodes with long shank. A, straight platinum tip. B, corkscrew platinum tip. C, handle. D, control button.

in the nasal tip cautery must be markedly reduced. If alternating current is used, an inexpensive small rheostat can be employed. If, however, direct current is used, a transformer is required.

FIG. 180. Corkscrew nasal tip cautery introduced into the cervical canal, and single line of cauterization established on withdrawing the tip.

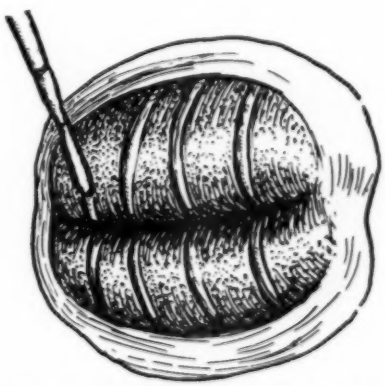

FIG. 181. Radial cauterization of the erosion of the cervix using the straight tip cautery.

Electrodes. (Fig. 179A and B) the electrodes should have shanks 6 to 8 inches long with various shaped platinum tips. These tips should be made of fine wire and be from one-half to

three-fourths of an inch in length. The handles (Fig. 179c) should be of the button variety so that the current can be controlled by the thumb.

Before using the nasal tip electrode the current is turned on and the rheostat opened sufficiently so that the platinum loop becomes a dull red. The nasal tip of the cautery is introduced cold into the cervical canal up to the level of the internal os (Fig. 180), and the current is turned on. A sufficient amount of time must be allowed for the electrode tip to become red before removal. In removing the tip it is pressed against the side wall of the cervical canal so as to make a single line of cauterization in the cervical canal. No more than two such streaks are to be made in the cervical canal at any one treatment. The erosion itself is then treated by radial cauterization. (Fig. 181.) The posterior lip of the cervix is cauterized first, using a dull red heat; if bleeding occurs, the tip is too hot and the current must be reduced. Linear cauterizations are made, beginning at the external os and extending outward; these are about one-half to three-eighths of an inch apart. The same procedure is carried out on the anterior lip.

*Pathology Following Cauterization.* If the cervix is examined three or four days after the cauterization it will be found to have a dirty, gray, necrotic appearance due to the destruction of the superficial glandular epithelium. In the second week the sloughs disappear, and a bright red, raw surface appears which bleeds readily. During the third week the stratified squamous epithelium begins to grow over the raw, red areas and gives them a pink appearance, in contradistinction to the remaining bright red areas still covered by glandular epithelium. Following cauterization there is always a marked increase in the vaginal discharge, which is occasionally blood tinged. Coitus should not be allowed during this period and the patient should be warned that a profuse vaginal discharge is likely to occur. Vaginal douches of salt water may be taken during this period for purposes of cleanliness.

At the second treatment the linear cauterization of the canal is carried out in another quadrant and the erosion is

cauterized radially between the previous cauterizations. As a rule four treatments will clear up the average erosion. These treatments *should not be given more often than once a month.* If the erosion is cauterized more often than once in four weeks, the lesion will not improve. This is due to the fact that sufficient time is not allowed for the stratified squamous epithelium to grow over the newly created raw area. If the patient must be seen more than once a month, the cervix may be treated with some bland antiseptic. If the cervical lesion does not heal with cautery treatments, properly given, it is probably not an erosion. If at any time there is any question about the diagnosis of a cervical lesion, a biopsy should be performed and the tissue examined by a competent pathologist to exclude carcinoma or syphilis.

What does this method of treatment accomplish? The heat from the cautery tip destroys a certain number of organisms; it also closes and destroys the mouths of some of the cervical glands. The closure of the mouth of the glands causes the gonococci to die from lack of oxygen. (Streptococci and staphylococci do not disappear.) The destruction of the glands causes a diminution of secretion from the cervical canal.

Why is it necessary to cauterize the erosion itself? At the distal edge of the erosion the two types of epithelium, the stratified squamous epithelium of the portio and the glandular epithelium of the cervical canal are in constant opposition. Any destruction of the glandular epithelium with an associated diminution of the alkaline cervical secretion allows the stratified squamous epithelium to grow into the destroyed area.

*Electrical Methods. Coagulation Treatment.* Armamentarium: (1) machine for delivering the coagulation current—spark gap (diathermy machine) or radio tube machine; (2) electrodes.

Machine for Delivering the Current. There are various types of machines on the market, any one of which is suitable for the purpose. However, each machine must be tested by the individual operator so as to determine accurately the dosage required for the proper depth of coagulation.

Electrodes. The original method was to place one electrode in the cervical canal and another on the abdomen; a current of sufficient strength to produce coagulation in the

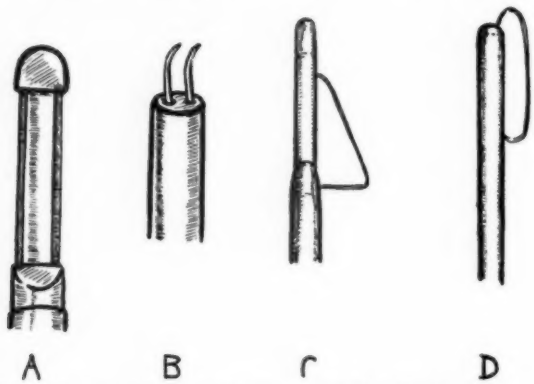


FIG. 182. A, bipolar electrode of the Ende type. B, bipolar electrode for coagulating surface of the erosion or for destruction of Nabothian cysts. C and D, various shaped cutting electrodes for use in the connization of the cervical canal.

cervical canal was then passed between the electrodes. This method never became very popular because variation in the size of the abdomen, skin resistance, etc., caused different requirements of current and it was therefore necessary to test each patient and set the machine in a different manner for each case. To overcome this variable factor Ende devised a bipolar electrode whereby both poles could be introduced into the cervical canal side by side. (Fig. 182A.) The two wires of this electrode were set one-fourth of an inch apart. As a result of having the positive and negative electrodes at a fixed distance, the resistance was reduced to a negligible amount and the same current could be used for practically every case.

Technique. The cervix is exposed and the vault of the vagina and the cervical canal are thoroughly cleansed. The bipolar electrode is introduced into the cervical canal and a section or quadrant of the canal is coagulated. It has been suggested by some authorities that the entire cervical canal be coagulated at one sitting. This procedure was tried in the Endocervicitis Clinic at Harlem Hospital and the results were far from encouraging. Several patients developed cervical

strictures; in one case the stricture was so tight that a haematometria formed. Two cases developed a parametric exudate. One may not be able definitely to place responsibility for the parametric exudates upon the massive coagulation, but the cervical strictures, of which there were many, were definitely the result of the coagulation. *A rule was therefore made that the entire circumference of the cervical canal should not be coagulated at any one sitting.* One should coagulate only a single quadrant. For the treatment of the erosion itself, a special bipolar electrical tip (Fig. 182B) can be used. This causes a coagulation of the superficial tissue between the tips. If Nabothian cysts are found, they can also be punctured and coagulated with this electrode.

*Excision with the Radio Knife—Hyams Technique.* The use of the radio knife to remove the cervical glands is electrical surgery utilized as an office procedure. Armamentarium: (1) machine for delivering the cutting current—radio tube or spark gap machine; (2) electrodes; (3) vaginal speculum with light.

Machine for Delivering Current. In the choice of an instrument for this type of work it is necessary to find one which will deliver a good cutting current combined with an adequate coagulation current. If the cutting current is faster than the coagulation, the cutting will be excellent, but one will be unable to see what is going on because of the hemorrhage. If, however, the instrument gives too much coagulation with the cutting current, then the danger of stricture as a result of mass coagulation must be considered. The proper choice of instrument in this type of work cannot be overestimated. It is of utmost importance that the operator, before attempting to use the cutting current on a cervix, thoroughly acquaint himself with the working of the machine he is going to use and the various electrodes. To do this, it is necessary to test the machine and electrodes on a piece of raw beef; in this way the operator will have a very good idea of the current necessary, the speed of the cutting, how fast the electrode must be moved, the quantity of coagulation, etc. One cannot over-

emphasize this preliminary training before using the cutting current on a patient.

Electrodes. An inactive metal electrode, about six inches square, which is moistened with a jelly lubricant or green soap, is placed on the patient's abdomen and covered with a sandbag. This electrode is connected with the negative pole of the high frequency machine. The positive or cutting electrodes (Fig. 182C and D) are of various sizes and shapes and are inserted into a handle which is connected with the cutting outlet on the high frequency machine.

Vaginal Speculum. It is essential in this work to have a speculum which is not made of metal and which does not conduct electricity, so that accidents may be avoided. The speculum should have some form of illumination or light attached directly to it so as to give a good light on the operative area.

Technique. The cervical canal is exposed and illuminated by a non-conducting vaginal speculum. The exposure and light must be good. The vault of the vagina and the cervical canal are thoroughly cleansed and dried. As a rule, in the use of cautery or coagulation no anesthetic is required, but in using the cutting current anesthesia is necessary. For this purpose, 50 per cent cocaine solution is introduced into the cervical canal on three applicators and allowed to remain there for five to ten minutes. This usually gives complete anesthesia. The depth of the cervical canal is measured and the proper electrode selected. (Fig. 182C and D.) This is attached to the handle of the instrument and the electrode is placed close to the cervical canal. The current is turned on just before the electrode touches the cervix; as soon as it touches the cervix there is a spark and the contact is closed. Using the silicon back of the electrode as a guide, it is introduced into the cervix for the entire length of the canal, allowing the current in the tungsten wire to cut its way into the tissues. When the inner limit of the canal is reached, the handle with the electrode is slowly turned through the arc of a whole circle (360 degrees) so as to cone out the entire canal with one sweep. The current is then turned off and the electrode removed. As a rule the diseased

cervical tissue will be attached to the tungsten wire; if not, it can be removed with a dressing forceps. If the operator does not desire to remove the entire canal with one sweep, the posterior edge of the canal may be removed first, then the anterior edge. As the tissue is removed from the posterior and anterior walls of the canal, the opening becomes cone-shaped with the apex toward the internal os. In this manner all the infected cervical glands can be removed under vision. After all the diseased tissue is removed a piece of iodoform gauze (one inch packing) is placed in the canal for twenty-four hours. This will usually control all bleeding that may occur. No douches or other vaginal treatments are necessary. The patient, however, should be warned that there will be a marked increase in the vaginal discharge which might be blood tinged.

Within two weeks the slough separates, at which time there may be slight bleeding. Enzymol, applied to the area on a piece of gauze packing, will help remove the slough more rapidly. No intercourse is allowed for one month. A second treatment is rarely necessary; occasionally in the sixth week or later it may be necessary to dilate the cervical canal to prevent stricture.

**Don'ts for all electrical treatments to the cervix:**

1. Do not turn on the current until the electrode is in the vagina or cervical canal and set in position for use.

2. Do not remove the electrode until the current is turned off.

3. Do not use this treatment during the acute stage of an infection, as parametritis and pelvic abscess may result.

4. Do not give the treatments too close to the menstrual periods as they frequently will produce a recurrence of uterine bleeding.

5. Do not over-coagulate, or strictures will result.

6. Do not coagulate entire canal at any one sitting; strictures may result.

7. Do not use the ordinary metal speculum, as the bipolar current touching the speculum may give the patient a burn.

8. Do not repeat the coagulation too soon; allow four to six weeks to elapse between treatments.

What are the clinical types of erosion?

1. *Congenital Erosion.* This is not due to infection, but to a physiological imbalance between the glandular epithelium of the cervical canal and the stratified squamous epithelium of the vagina, as a result of which glandular or columnar epithelium is found covering the entire cervix and occasionally the upper one-third of the vagina.

How does this occur? The tubes, uterus and the upper two-thirds of the vagina are all developed from the Müllerian ducts. (Fig. 124.) Thus the epithelium lining the tubes, the uterine cavity, the cervical canal, the portio vaginalis and the upper two-thirds of the vagina are all developed from the same structure. If, during a child's life, there is a physiological imbalance between the epithelium of the cervical canal and the stratified squamous epithelium of the vagina, the cervical epithelium does not stop at the external os but covers the portio vaginalis and occasionally a part of the vaginal vault. When, however, normal reactions, both endocrinological and physiological, take place, the congenital erosions disappear. Occasionally it recedes too far and one finds the stratified squamous epithelium extending upward into the cervical canal. As a rule this type of erosion requires no treatment.

2. *Erosion of Pregnancy.* This is another erosion not due to infection. Here, due to the marked hypertrophy of the cells in the cervical canal (an increase in the size rather than any increase in the number), there is not room enough in the cervical canal for the glandular epithelium. As a result the glandular epithelium of the canal is pushed out through the external os. This is not a true erosion; it is just an eversion of the mucous membrane of the cervical canal.

3. *True Clinical Erosion.* The true clinical types of erosion may be classified as: (1) simple erosion; (2) papillary erosion; (3) cystic erosion.

Simple Erosions. These present a fairly smooth red area immediately surrounding the external os. Histological examina-

tion shows the area to be covered by a single layer of columnar epithelium.

Papillary Erosion. As a result of prolific down-growth of glandular epithelium, throwing the erosion into rugae; the red surface appears rough and may show fine finger-like projections. Histologically one sees definite gland formation.

Cystic Erosion. If, during the process of healing of the above erosions, the mouths of some of the glands become closed or bridged over by the stratified squamous epithelium, the glands become transformed into cysts (Nabothian cysts). Clinically they appear as translucent areas under the pink mucous membrane.

*Symptomatology.* Erosions may present no symptoms or the patient may complain of leucorrhea, backache, feeling of weight in pelvis. Distention of the cysts in the erosion occasionally causes reflex pelvic symptoms and sometimes pain in the breasts. Puncture of these cysts with the cautery or the bipolar coagulation current destroys their lining cavity and stops the reflex symptoms and breast pains.

### TRICHOMONAS VAGINALIS VAGINITIS

Donné, in 1836, discovered the presence of a parasite in the vaginal discharge of patients and to it he applied the name of Trichomonas vaginalis. It is only recently that attention has again been drawn to the parasite. Routine examination of the leucorrheal discharge of all patients shows this organism to be present in about 30 per cent of the cases. The method by which this parasite becomes implanted in the vagina is still uncertain. It is suggested that it may be acquired from the male during coitus, or that it is secondary to a trichomonas infection of the rectum. This organism is frequently found associated with other bacteria in the vaginal discharge of patients, but whether it is the etiological agent producing the vaginal discharge is still a moot question. Some authorities believe that the vaginitis is a symbiotic infection produced by the trichomonas and the streptococci acting together.

*Symptomatology.* The patients present themselves with a profuse, irritating, foul smelling vaginal discharge that resists

the usual methods of treatment. They complain of itching and irritation around the vulva. The uninitiated will very often incorrectly diagnose these cases as gonorrhea, thereby causing

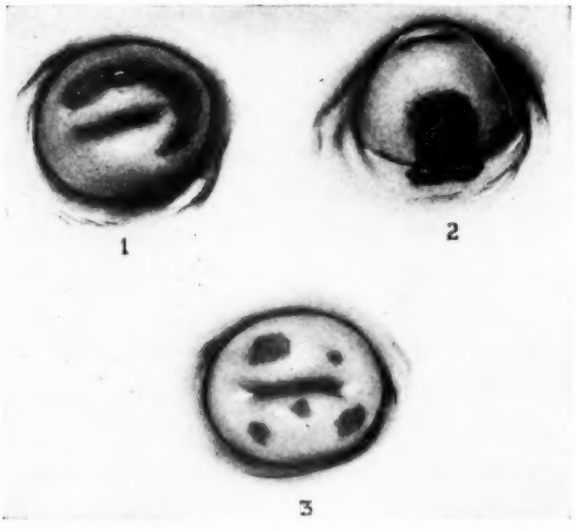


FIG. 183. Various types of eccentric cervical erosions seen in trichomonas vaginalis vaginitis. 1, Horseshoe-shaped erosion. 2, Lesions extending to vaginal vault; this location is commonly affected. 3, Multiple superficial scattered lesions which bleed readily. (From Kleegman in *Surg., Gynec. & Obst.*, 51: 552, 1930.)

irreparable harm. This condition may occasionally be seen following a gonorrheal infection after the gonococci have entirely disappeared. *In any case of gonorrheal infection where the discharge does not cease after the gonorrhea has apparently been cured, a trichomonas infection should be sought for.*

Speculum examination shows a profuse, milky white, frothy vaginal discharge, the mucosa definitely irritated and having a "strawberry-like" appearance. The cervix, vagina and labia are markedly reddened. The portio may have small ulcerations on its surface which bleed readily. (Fig. 183.) The vaginitis may be so acute that the introduction of a finger causes severe pain. Dyspareunia is a frequent symptom. Complete vaginal examination may have to be deferred until the vaginitis is controlled.

*Diagnosis.* The diagnosis is suggested by the clinical appearance and the symptomatology of the case and is verified by seeing moving trichomonads in the unstained wet drop.

**Don'ts:** Do not let the patient take a douche or use any vaginal medication for forty-eight hours before coming to the office for a wet smear.

Do not use lubricant of any kind on the speculum or gloved finger when the smear is taken.

Do not use cold saline for the wet drop. The saline must be warm, at least body temperature.

Do not rule out a trichomonas infection on the absence of the organisms in one wet spread. Instruct the patient to return in three days, omitting all douches and vaginal treatments over this period. If reexamination is negative on two subsequent examinations at three day intervals, trichomonas infection can be ruled out.

*Technique of Making the Wet Drop.*

1. Heat the saline to slightly higher than body temperature.
2. Have the microscope ready for use.
3. Insert a dry speculum into the vagina exposing the vaginal vault. If it is necessary to lubricate the speculum, do so with saline or the patient's own vaginal secretion.
4. Put a drop of warm saline on the slide.
5. Put a drop of vaginal secretion in the warm saline with a platinum loop.
6. Put on a cover slip and examine the slide immediately.

In the untreated case with moderate or severe symptoms the parasite is readily identified under the high power dry lens as a rounded organism, roughly pyriform in shape, moving slowly or rapidly. (Fig. 184.) This motion is probably caused by undulations of the surrounding membrane and not by the flagellates which are present; the latter cannot always be seen. When the trichomonas is caught in a group of cells or débris it causes the entire mass to move from side to side. When dead, motion ceases and the parasites cannot be differentiated from pus cells. It is the motion of the cells that aids materially in

the diagnosis. If the cells are not moving the diagnosis cannot be made on the wet unstained drop.

*Treatment.* As the pathogenicity of the trichomonas is

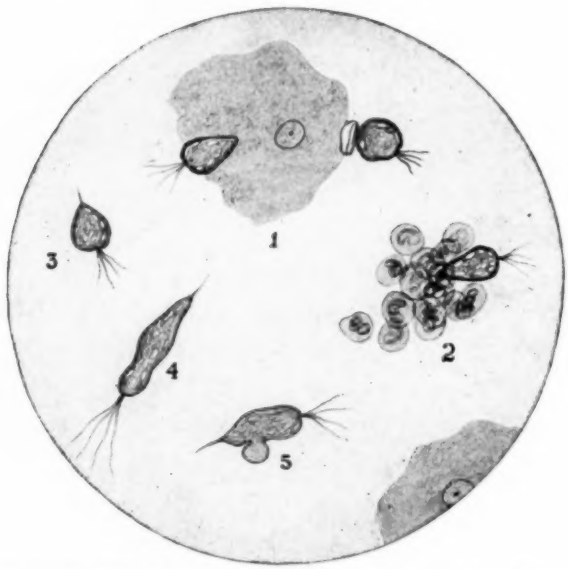


FIG. 184. Trichomonas vaginalis, Donné, as seen in a wet preparation. 1, Two organisms caught by an epithelial cell. 2, Organism in a clump of pus cells. 3, Pear-shaped organism; this is the typical form. 4, Slipper-shaped organism, often seen in an untreated case. 5, Pseudopod formation, which is infrequently seen. The trichomonads are recognized only by their characteristic motion, for when dead, they are indistinguishable from the pus cell. (From Kleegman in *Surg., Gynec. & Obst.*, 51: 552, 1930.)

still in doubt, the treatment is of necessity very variable. There is no single plan of treatment for the cure of this condition. The literature abounds with methods of treatment advocated by various authors.

Basically the office treatment consists of:

1. Thorough mechanical cleansing of the vagina with green soap and water or some mild antiseptic.

2. Thorough drying of the vagina.

3. The application of some non-irritating antiseptic, such as 2 per cent aqueous mercurochrome or pure pyroligneous acid, removal of the excess and thorough drying of the vagina.

4. The introduction of a bland ointment (Lassars paste N.F.) on a kitetail tampon (Fig. 185A) to prevent the surfaces of the vagina from coming in contact. This tampon is

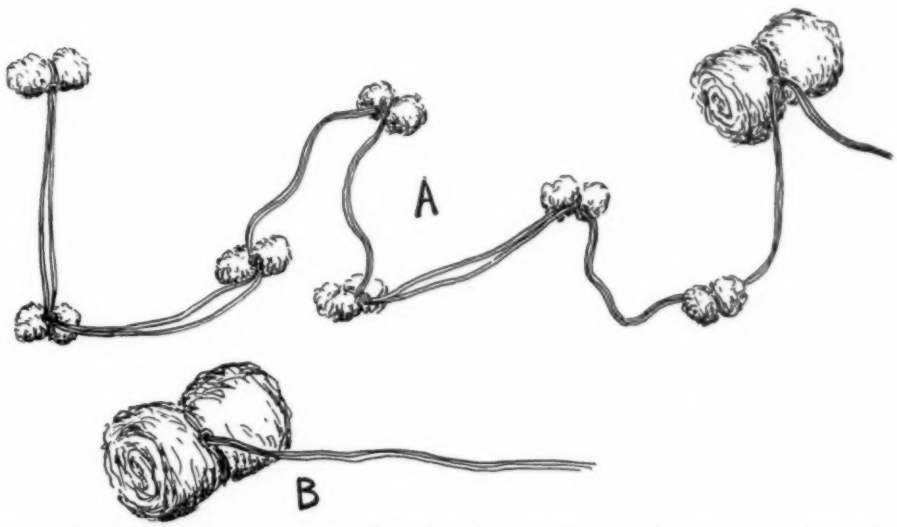


FIG. 185. A, kite-tail tampon; small wads of cotton tied together on one string with a fairly large tampon on the end. The Lassars paste is heated, the tampons are dipped into the paste, then hung, allowed to harden, and placed in a wide-mouthed jar. The large tampon at the end is not dipped in the Lassars paste. B, ordinary rolled tampon. One end should be allowed to stand in whatever medication is to be used, i.e., 25 per cent boroglycerite of glycerine, ichthyol, etc. The tampon is made of absorbent cotton, closely rolled and tied.

allowed to remain in the vagina for three or four days. It is a remarkable fact, but tampons coated with Lassars paste remain "sweet" in the vagina for three to four days even though the patient is menstruating.

*Home Treatment.* The simplest form of home treatment consists in the use of a concentrated (25 per cent) salt solution douche. A glassful of salt to four glassfuls of hot water, the douche to be taken as directed on page 210. The concentrated saline not only acts as a cleansing douche but also as a therapeutic agent. It has been shown that 25 per cent saline causes the motility of the parasites to cease and their shape to undergo a radical change. The organisms become markedly shrunken and to all appearances dead. The later application of warmed normal salt solution does not rejuvenate them.

*Chemotherapy.* The parasites are susceptible to any number of germicides, most of which in weak solution kill the organism. The use of various arsenical suppositories, such as

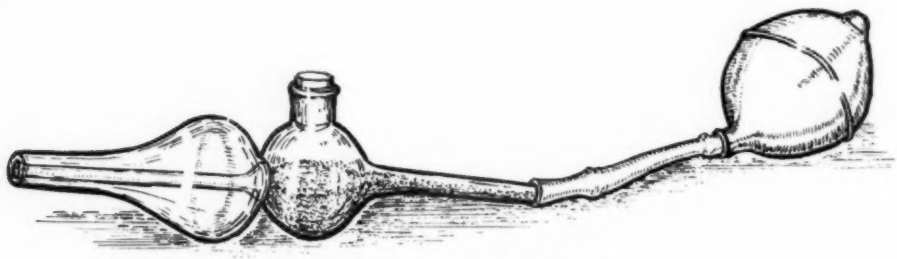

FIG. 186. Holden powder blower.

carbasone (2 gr.) in a glycerine gelatin base have proved very efficacious. Mercurochrome 2 to 4 per cent in aqueous solution, silver picrate and picric acid either in local application or suppositories, have all been used with good results. Occasionally in sensitive patients these germicides are harmful not only to the parasites but also to the host, producing nephritis, optic changes, local destruction of tissue and occasionally a severe dermatitis. When using these germicides, particularly the arsenical or picric acid preparations, the patient must be watched constantly for any local or general toxic manifestations.

*Dry Powder Treatment.* The use of a powder in the vagina has frequently been recommended for all types of irritating vaginal discharges (Nassaver, Gellorn, Holden). The application of powder to the vagina with a powder blower causes it to reach all the crevices. These powders, being hygroscopic, absorb all the moisture, depriving the infecting agents of necessary water, thus helping to make them harmless. The powders also absorb the discharge, lessening the external irritation, thereby giving the patient almost instant relief.

With the use of the powder blower (Fig. 186), patients can be readily taught to insufflate various absorbifacients or medicated powders into the vagina. To use the insufflator properly it is necessary to:

1. Have the end of the powder blower in the vagina, with the labia snugly fitting its sides.

2. Have sufficient powder in the middle glass chamber, (have the powder just above the level of the center tube) to insure powder and not air being blown into the vagina.

3. Use sufficient force in compressing the bulb so as to completely distend all the folds in the vagina and have the powder reach all the recesses.

4. Insufflate the powder into the vagina nightly and compress the bulb at least three times with each treatment.

The various powders such as kaolin, fullers earth, quinine sulphate, acetarsone, cinquarsen, perborate, silver nitrate 1 per cent in kaolin, tannic acid, etc., alone or in combinations, can be used.

If one regards a vaginitis as a condition simulating a dermatitis, the use of a dry powder to absorb the moisture and to keep the surfaces from coming in contact is excellent treatment. Although the powder treatment of itself may not cure a vaginitis or a trichomonas infection, it certainly helps keep the patient symptom-free during any period of time when she cannot come to the office for the radical office treatment. The occasional use of the powder blower (twice a week) in the vagina following an apparent cure of the trichomonas infection seems to prevent recurrence of the infection. Drying seems to kill the organisms very readily and there is no better method of keeping the vagina dry than by having the secretions absorbed by a powder.

During menstruation the parasites seem to grow most rapidly. It is therefore essential to give the patient an office treatment during this time. Should an associated gonorrhea be present, the parasitic infection must be disregarded until the gonorrhea has been cured.

*Question:* When is the patient considered cured?

*Answer:* The patient may be considered cured when, after treatment through three consecutive menstrual periods, the symptoms have disappeared and no organisms are found in the vaginal secretion each month for three successive months following the cessation of all treatment.

*Question:* What routine should one follow when the diagnosis of trichomonas vaginalis is made?

*Answer:* 1. Basic office treatment every five to seven days.

2. Following the removal of the Lassars paste tampon, the patient should take a 25 per cent salt water douche every day until the next treatment.

3. This treatment should be carried out through three consecutive menstrual periods.

4. The patient on discharge should be taught to use the powder blower with kaolin once or twice a week.

### THERAPEUTIC VALUE OF HEAT IN THE VAGINA

The local application of heat to any part causes first a vasodilatation which is followed later by a contraction of the vessels. This is readily shown in the application of a hot sponge to an oozing surface—at first there is a slight increase of bleeding, but this is rapidly followed by marked contraction of the vessels with arrest of the hemorrhage. This contracture of the vessels can be clearly demonstrated in the vagina where, following any prolonged application of heat, one will find the mucous membrane presenting a blanched appearance.

Prolonged application of heat to the vaginal vault stimulates pelvic circulation. This causes an increase in the number of leucocytes as well as an increase in the lymphatic circulation in the pelvic area. Following the application of heat the vessels contract and remain contracted for a considerable period of time, thereby diminishing venous stasis.

Pelvic infections of gonorrheal or puerperal origin cause varying amounts of exudate to collect in the pelvic tissue (tubes, broad ligaments, etc.). As a result of this inflammation there is a moderate venous stasis with a slowing of the blood stream in this area. Aided by the free anastamosis of the vessels in the pelvis, the prolonged application of heat stimulates the circulation and causes the more rapid absorption of the pelvic exudate with speeding up of the reparative processes. The heat also produces a marked increase in the amount of cervical and vaginal secretion. Examination of the vagina following the

prolonged application of heat always shows the presence of a profuse glairy watery discharge.

How can this prolonged heat be applied?

Diathermy, short wave, Elliott treatments and prolonged hot vaginal douches.

Patients should receive all heat treatments whether with a diathermy, short wave or Elliott machine, in a slight Trendelenburg posture and should remain in this position for one-half hour after the treatment is discontinued in order to aid the venous return flow.

The use of diathermy and short wave machines produces definite heat in the pelvis. Their value cannot be questioned, since they produce heat in a definite area in a short space of time.

*The Elliott Machine.* Dr. Charles R. Elliott devised a simple apparatus consisting of a reservoir for hot water, the temperature of which is maintained by a rheostat (electrical unit). This water is delivered to a thin, distensible gum rubber bag which is placed in the vagina and distended so as to obliterate all the vaginal folds. The water is removed from this bag by a suction pump and returned to the reservoir to be reheated and returned to the patient. This apparatus is simple; its management can be learned by anyone in a very short time and it is practically "fool proof."

As no water comes in contact with the patient, the temperature of the water used in the Elliott bag can be much higher than that in an ordinary douche, and as there is no maceration of the mucous membrane from the water, the treatments can be given daily. The temperature of the water at the beginning of the treatment varies from 110–115 °F.—this is gradually increased so that at the end of the treatment (thirty minutes to one hour later) the temperature of the water is between 125–130 °F. Some patients complain of the heat after 120 °F. has been reached. In these cases the rheostat may be so regulated that the temperature does not exceed 120 degrees or the treatment may be shortened to one-half or three-quarters of an hour. Examination of the vagina

after the treatment will always show a considerable amount of a watery and glairy discharge.

The prolonged hot water douche accomplishes the same results as the above method of treatment. It has, however, certain disadvantages: (a) it is difficult to maintain the temperature at a constant level for any considerable period of time; (b) a lower degree of heat must be used because of the sensitivity of the external as well as the local tissues to wet heat; and (c) the douches cannot be given every day without causing maceration of the vaginal mucous membrane.

*The Vaginal Douche.* Daily douching is neither necessary nor essential. The normal vagina is clean and contains no decomposing matter which must be washed away. Habitual douching may wash away the normal protecting agents present in the vagina. However, the vaginal douche should not be condemned on general principles. It has certain definite uses: (1) mechanical, cleansing and local antiseptic effect; and (2) the heat effect to the cervix, vaginal tissues and the adjoining pelvic organs.

The Cleansing Douche. The principle purpose of this form of therapy lies in the removal of abnormal secretion. To expect the douche to produce any definite alteration in the bacteriology of the vagina is overestimating its possibilities. In its brief contact with the vaginal mucous membrane it can only act in a mechanical manner.

In prescribing a cleansing douche it is best to prescribe a stock solution or powder; saturated solution of potassium permanganate drams 1, to 2 quarts of warm water; boric acid, tannic acid, or zinc sulphate powder, equal parts or either powder alone, 1 dram of the powder to 2 quarts of warm water. The addition of 10 to 15 gr. of menthol to 4 ounces of any of these powders produces a cooling and more pleasant after effect. Salt or sodium bicarbonate may also be used. The temperature of the cleansing douche need not be over 105°F.

*Heat Effect:* In using the douche for its heat effect, there are several essential details that must be carried out.

First, the temperature of the water delivered into the vagina must be at least 110°F. As the douche is being

given and the tissues accommodate themselves to the temperature, it can be raised. The temperature of the fluid, however, should never be raised to the point of discomfort.

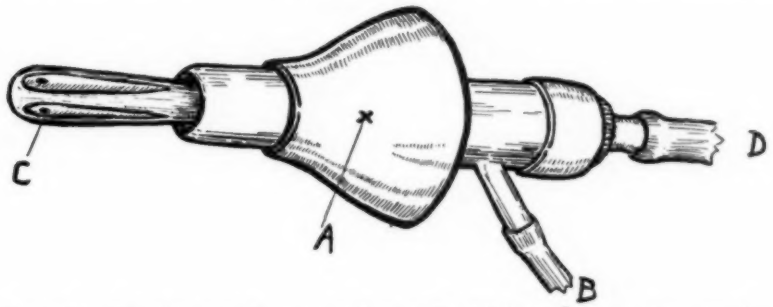


FIG. 187. Douche nozzle. A, rubber cuff which fits the vulva snugly and prevents leakage of fluid over perineum. B, outflow tube. C, openings on inflow tube. D, inflow tube.

Second, the quantity of water must be sufficient to allow the heat to be maintained for a definite period—twenty minutes or more; this requires from 2 to 4 gallons of fluid. Third, the patient must lie on her back with her hips elevated so as to aid the inflow of water, the distention of the vagina and the venous return flow in the pelvic veins. Fourth, the patient should rest for one-half to one hour following the douche. If the patient takes the douche herself it is preferable for her to take it at night just before retiring.

*Technique of Giving or Taking a Vaginal Douche.* Too often in prescribing a douche the physician simply tells the patient "take a douche," and the effect obtained is as valueless as the meagerness of the instruction. To obtain the best effects it is essential to go into the minutest details of just how the patient should take the douche. The nozzle for the douche should be one on the order of the "French douche nozzle." (Similar to Fig. 187.) With this type of nozzle the soft rubber portion (Fig. 187A) can be pressed against the outlet of the vagina so as to prevent any leakage of fluid from the vagina. The inflow is started very slowly; during this procedure the outflow tube (Fig. 187B) is pinched, allowing the fluid to collect in the vagina and distend it, thus allowing the fluid to reach all parts of the vaginal vault. When the patient feels the vagina distend, she releases the outflow tube and the fluid

escapes. This can be repeated as often as necessary. To prevent any of the fluid from entering the cervix, uterus, etc., as a result of a direct hit, the openings (Fig. 187c) on the inflow tube must all be on the side of the tube. *There should be no openings at the tip of the nozzle. All douches must be taken lying flat on the back with the hips elevated.*

The vaginal mucous membrane is less sensitive to temperature than the outer skin. As a result, with the use of this type of nozzle, a douche of a much higher temperature can be given, as the water does not come in contact with the skin of the perineum. The douche can (much preferred to the bag) should never be more than 2 feet above the buttocks. There is no purpose in giving a douche under pressure; complications such as fluid entering the uterus may result. In order to maintain a continuous flow of water of constant temperature, Gellhorn recommends attaching the inflow tube of the two-way nozzle directly to the spigot of the bath tub, setting the valves so as to mix the water at the proper temperature and under low pressure. In this way a continuous application of hot water can be carried out for any period of time.

## GONORRHEA

*Urethritis.* The urethra in the female is a short simple tube with a sphincter at one end and a few glands at the other. There are practically no glands in the urethral canal itself; thus it differs from the male urethra with its complicated structure.

Owing to the anatomy of the vestibule and vagina, young females and virgins, when exposed to an infected male, practically always develop a urethritis. In the multipara with a wide open vagina the urethra may escape. Three instances of pure urethritis of gonococcal origin have been personally observed, where there has been an intact hymen and no vaginal infection.

Gonorrheal urethritis in the female is as a rule a self-limited disease and frequently will disappear entirely with very little or no treatment. Although the infection may entirely disappear

from the urethra a few infected follicles (Skene's glands) may remain. These ducts or blind tubules are usually two or more in number situated on either side of the urinary meatus. When they are inflammed they cause a pouting of the urethral orifice, and the mouths of these glands can usually be seen as two red dots, one on either side of the floor of the urethra; with gentle vaginal massage from below upward, a drop of pus can usually be expressed from their center.

In the acute stage the urethral orifice has a bright red angry appearance with yellow pus presenting at the meatus. If the pus around the vestibule is wiped away and the urethra is milked with the vaginal finger from behind forward, fresh pus can be obtained for smear or spread. This pus usually contains gonococci. In a few days the condition becomes subacute or chronic, the redness disappears from the meatus and the major portion of the discharge disappears. In this stage gonococci can be recovered from an apparently clean urethra by milking it from behind forward or by taking a spread from Skene's glands.

*Symptomatology.* These patients all complain of burning on urination; occasionally the condition must be differentiated from a true cystitis. Cystitis of gonorrheal origin is practically unknown, but a trigonitis may occur.

| True Cystitis | Gonorrheal Urethritis |
|---|---|
| Spasm pain at end of urination. | Burning at the beginning of urination. |
| Frequency of urination. | Frequency not so markedly increased. |
| Straining on voiding. | Tenesmus is rare. |
| The three glass test will show cloudy urine in all specimens. | The three glass test shows cloudy urine in first specimen, whereas the second is clearer and the third may be entirely clear. |
| Chills and fever. | No fever present. |

*Treatment.* Three lines of treatment may be followed: (1) no treatment; (2) radical active treatment; and (3) conservative active treatment.

No Treatment. Those who disregard the urethral infection do so because they feel that it is self-limited, the complications are few and the process frequently disappears or remains only

in Skene's glands and that the latter can be treated when the infection becomes chronic.

Active Treatment. During the very acute stage no treat-

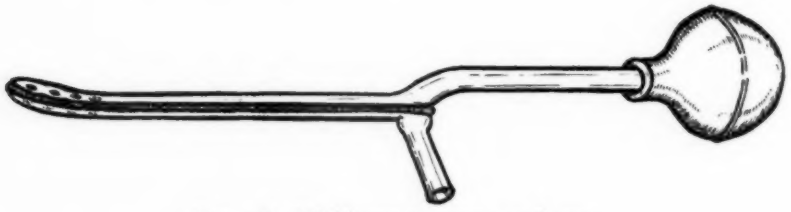

FIG. 188. Dickinson two-way catheter.

ment should be carried out except to force fluids, apply warm wet compresses of boric acid or aluminum acetate externally, or take hot sitz baths. In the subacute stage the urethra is treated by warm irrigations of acriflavine or potassium permanganate 1:5000. The irrigating can should never be higher than 2 feet above the buttocks. A sterile two-way catheter (Fig. 188) is introduced into the urethra very slowly, allowing the fluid to run continuously; this washes out the urethra until the sphincter is reached. When this is passed, about 200 c.c. of fluid is allowed to flow into the bladder, the catheter is slowly withdrawn and the urethra is again irrigated with the remaining fluid. Immediately following this the patient is allowed to pass the fluid in the bladder which further washes out the urethra. This active treatment can be carried out every day and the infection should disappear in three to four weeks.

When the urethral smear is negative on three successive examinations, treatment to the urethra is discontinued even though the cervix still requires treatment.

Conservative Active Treatment. No local treatment during the early active period, simply force fluids, urinary antiseptics, warm wet compresses, sitz baths, etc. During the subacute or chronic stage, urethral instillations of one-half ounce of 10 per cent argyrol or one-half of 1 per cent protargol are used daily. The patient first voids so as to wash out the urethra and the instillation is given by placing an olive tipped

urethral syringe against the urethra and slowly causing pressure on the piston. This forces the solution into the urethra, dilates it and thus the entire urethral canal is treated before the sphincter opens and allows the excess of solution to flow into the bladder.

In between office visits the patient may introduce into her urethra, urethral suppositories 2 inches long, ⅛ inch in diameter, containing ½12 gr. silver nitrate or ½12 gr. protargol. This treatment is discontinued after three or four weeks, when repeated urethral spreads are negative.

Frequently the infection will disappear entirely from the urethra but will remain in Skene's ducts. Smears taken from these tubules will continue to be positive for gonococci. Under these circumstances the tubules must be destroyed. If their orifices do not present themselves readily, they can be exposed without difficulty by the use of the back end of a bent hair pin held by an artery clamp and used as a retractor. The area should be anesthetized by the local application of 10 per cent cocaine followed by the injection of 1 per cent novocain into the tissues. The novocain causes the mouths of the tubules to become prominent. The nasal tip cautery is introduced into the tubule, the current turned on and the entire tubule destroyed. The same procedure may be carried out using the coagulation current. The negative electrode is placed on the abdomen of the patient. The positive electrode, a dull pointed needle, is introduced into the tubule, the current turned on and the gland coagulated.

*Gonorrheal Cervicitis.* In the acute stage of gonorrheal cervicitis the cervix is very red and swollen and there is a profuse purulent discharge. This acute form of cervicitis, however, may not always develop or the patient is not observed during this early stage. As a rule when the patient presents herself for treatment the cervical lesion is already in the subacute or chronic stage.

The treatment of the cervical lesion in gonorrhea lies, not so much in the local lesion itself, as in the prevention of the ascent of the infection through the uterus to the tubes. (See

page 71.) Toward this end it is essentially to instruct the patient in the necessity of:

1. Absolute sex rest—no sex excitation or intercourse.
2. Abstinence from all alcoholic drinks.
3. The avoidance of all spicy foods.
4. Absolute rest in bed with the first sign of menstruation until the period is finished.

In the acute stage all manipulations in the cervical canal should be avoided. The cervix is exposed and all the pus in the vagina wiped away with absorbent cotton balls. The patient is then placed in a slight Trendelenburg posture and about 1 ounce of a gonocide, such as argyrol 10 per cent, protargol 5 per cent or acriflavine 2 per cent, is placed in the vault of the vagina. She should remain in this position for about ten minutes so as to allow the drug to enter the cervical canal by gravity. An absorbent cotton tampon is then placed in the vagina and the speculum removed. This tampon is removed in six to twelve hours. At this same time treatment to the urethra is carried out. It is surprising to see in how short a time the cervical lesion enters the subacute or chronic stage.

*Treatment of Subacute or Chronic Endocervicitis.* In this stage the cervical canal requires direct treatment. Before this can be carried out it is essential to remove all the thick tenacious muco-pus from the canal. Under a good light the cervix is exposed and the vaginal vault is cleansed. The cervical canal is then wiped out to remove the tenacious mucus; for this purpose applicators, or small pieces of one-inch packing dipped in caroid powder or saturated solution of sodium carbonate and peroxide of hydrogen, equal parts, is very effective.

Following this the cervical canal should be treated up to the internal os with strong silver nitrate solution, 5 per cent, 10 per cent up to 15 per cent (Kidd and Simpson). Some authorities recommend that this be immediately followed by tincture of iodine (Churchill's solution), so that a silver iodide is formed.

The idea of using these strong antiseptics is: first, to destroy some of the gland producing surface; and second, to kill some of the organisms. When the cervical lesion is chronic, after six

weeks, the cautery, coagulation current or radio knife (conization) may be used.

The use of heat in the form of hot douches, Elliott treatment, etc., should accompany the above methods. Some authorities are recommending "hot box" therapy, i.e., raising the temperature of the body to 106 or 107 degrees for six, eight or ten hours as a means of curing the gonorrheal infection. There is no question that it does cure in some cases, but this method should only be used by competent physiotherapists under the strictest supervision.

*Sulfanilamide.* In association with the regular treatment some observers recommend the use of sulfanilamide. The dosage generally employed is

20 gr. four times daily for first two days
15 gr. four times daily for next three days
10 gr. four times daily for four to eight days
} Total for adults 100–132 5 gr. tablets

## VULVOVAGINITIS IN CHILDREN

Vulvovaginitis occurs in two forms, gonorrheal and non-gonorrheal. Whether the gonorrheal form is caused by gonococci of the adult type is not important for this discussion. Morphologically they resemble the adult gonococci, but the absence of infection above the cervix and the absence of gonorrheal ophthalmia speaks strongly against its being the same organism.

Clinically the cases are characterized by a vaginal discharge, ranging from profuse to scanty, from serous to purulent. The external genitals usually show signs of inflammation and may be covered with crusts. Examination of the vagina with the vaginoscope (Fig. 189), reveals areas of redness and apparent ulceration; these may later in adult life manifest themselves as partial or total vaginal strictures.

The treatment may be divided into local and systemic. These children are frequently undernourished and slovenly in habits. They should receive a plentiful bland diet with milk as the main food. Absolute cleanliness should be insisted upon

with frequent washing of the external genitals and frequent changing of clothes so as to keep the local parts dry.

*Local Therapy.* The literature abounds with various forms

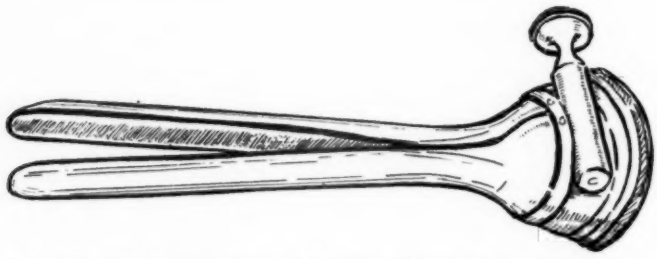

FIG. 189. Vaginoscope for children. This can be made from a bivalve nasal speculum by extending the blades the necessary distance. The thumb screw separates the blades and allows inspection of the cervix.

of therapy, indicating that no one form has given universally good results. For years the recognized home therapy consisted of potassium permanganate douches, 1 dram of a saturated solution to 2 quarts of water, irrigating the vagina daily, using a soft rubber catheter. Office treatment consisted in the introduction into the vagina of one-half ounce of 10 per cent argyrol or 1 per cent protargol suppositories in cocoa butter.

Stein and his associates have used 1 per cent mercurochrome, incorporated in hydrous wool fat, mixed with an equal amount of petrolatum. This mixture is solid at room temperature; it is warmed to render it soft, and is injected daily into the vagina. This gave good results, but the mothers complained of the soiling of the linens. These authors are now using a boroglycerine suppository with a gelatin base containing 1 gr. of silver picrate to each suppository. This is introduced into the vagina by the mother every night after thorough outside cleansing with castile soap and water. As the patients' symptoms improve, these treatments are spread to every other day, every third day, every week and then discontinued. No treatments are given the day before the patients come to the clinic. At each visit to the clinic vaginal spreads are made, and the patients are declared cured when smears are negative for three successive months.

*Systemic Treatment.* Vaccine Therapy. Stock vaccine containing gonococci, colon bacilli, staphylococci and streptococci obtained from the vaginal cultures of a female child, have given good results in the hands of some observers, beginning with a very small dose and gradually increasing it.

Hormonal Therapy. The vaginal mucosa of a child is composed of six to fourteen layers of squamous epithelial cells. The adult vagina, which is very resistant to the gonococcus, is composed of twenty-five to forty layers of epithelial cells. Lewis showed that by the administration of theelin, 100 rat units daily by hypo, the vaginal mucosa of a child could be hypertrophied to approach that of the adult; in this way he was able to cure many long standing cases of vulvovaginitis in about ten days. Theelin in vaginal suppositories is also recommended.

Sulfanilamide. In the treatment of vulvovaginitis some men claim very good results with sulfanilamide. The dosage varies from 30 to 45 gr. daily in divided doses, depending upon the age and weight of the patient. The dosage is more frequently computed on the basis of body weight, giving 50 mg. (¾ gr.) per pound of body weight per twenty-four hours, divided into four or six doses. In very small patients this may be reduced to 40 or 45 mg. per pound of body weight.

## SENILE VAGINITIS

This condition is usually seen amongst elderly women or in younger castrates. Clinically the patients present an atrophic cone-shaped vagina, the cervix and vaginal vault showing numerous small areas of ulcerations and adhesions. These ulcerations bleed to the touch. The rest of the vagina may show areas of haemorrhagic stippling. The vulva may be atrophic and shriveled. Most of these patients complain of a thin vaginal discharge tinged with blood with itching and burning in the vagina.

This condition is apparently due to an absence of the estrogenic hormone. These patients are all benefited and frequently cured by the use of 10,000 units of theelin-in-oil

given three times a week over long periods of time (two to three months).

Locally Gellhorn recommends two tablespoonfuls of pure pyroligneous acid introduced into the vagina through a tubular speculum with the patient in slight Trendelenburg position, for ten minutes. The excess is then removed and the vagina painted with 5 per cent silver nitrate solution followed by a plain cocoa butter suppository. This is given every other day for two weeks and usually results in relief which is effective for months.

### VENEREAL WARTS

Pointed condylomata or condylomata acuminata are usually found in patients with an irritating, offensive vaginal discharge which may or may not be of gonorrheal origin. Clinically they appear as wart-like growths on the labia, the skin of the perineum, around the anus and in the vagina. There is a tendency for these wart-like growths to group themselves into cauliflower-like masses and thus give the appearance of large, hard, pigmented masses almost completely covering the labia. Histologically these masses show the typical appearance of the common wart; the growth is entirely superficial and there is no tendency for infiltration at the base.

*Medical Treatment.* The basic etiological discharge must be controlled or cured before one can expect to cure the warty growths and prevent their recurrence. For this purpose the use of the powder treatment: kaolin, Lassars paste, etc., described in the treatment of trichomonas vaginalis vaginitis (page 204) is to be recommended. The large tumor masses may be removed surgically without difficulty. The smaller ones can be destroyed with the nasal tip cautery or removed with scissors, the base bleeding but slightly. Medically, the smaller lesions may be cauterized with nitric acid, ferric chloride or carbolic acid and tincture of iodine, equal parts.

To remove the warts electrically, they must be anesthesized by the local application of 10 per cent cocaine solution for five minutes, or the base must be infiltrated with a 1 per cent

novocaine solution. Following this the bipolar pointed electrode (Fig. 182 B), attached to a suitable diathermy or electrical coagulation current is introduced into the wart and the current

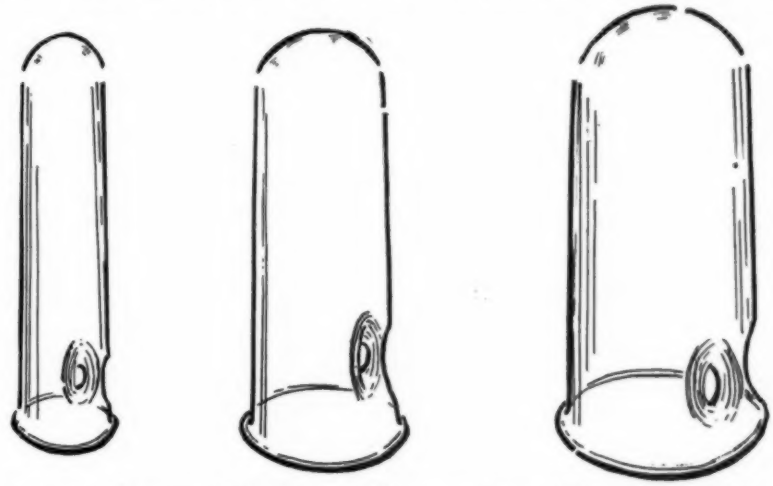

FIG. 190. Glass vaginal dilators. There are seven dilators of varying sizes, from very small to quite large. Only three are shown here.

turned on until the warts appear white. Within a week the warts drop off and the area soon becomes covered by epithelium. Kaplan states that these tumor masses disappear very readily following small doses of *x*-ray.

### DYSPAREUNIA

Dyspareunia, difficult or painful intercourse, must be differentiated from vaginismus, or involuntary reflex spasm of the sphincter muscles of the pelvic floor due to hyperesthesia.

Where the etiology of the dyspareunia can be identified, it should be removed. The most frequent causes found in recently married women are a rigid hymen, underdevelopment of the vagina, atresia or stricture in the vagina. These conditions can, as a rule, be overcome by the gradual dilatation of the hymen or the vaginal orifice, using well lubricated dilators. (Fig. 190.) Before using these dilators, the area may be anesthetized by nupercaine ointment 1 per cent. The dilators are gently introduced into the vagina by the physician; the largest one that enters is given to the patient with instructions to use it night and morning until it enters the vagina without pain or

difficulty. When she is able to do this painlessly she returns to the office and is given the next size to use in the same way until sufficient dilatation has been obtained.

If the hymen is so rigid that it will not dilate or the patient has an associated vaginismus, it may be necessary either to excise or to incise and stretch the hymenal opening under general anesthesia. The vagina is then packed with vaseline gauze or the largest sized vaginal dilator is inserted and held there with a "T" binder. This is removed after two days and the dilator given to the patient for home treatment.

Inflammations, such as vaginitis, vulvitis, Bartholin's abscess and urethral caruncles, must be treated by appropriate measures.

### CERVICAL POLYPS

Cervical polyps arise either from the endocervix or from the portio vaginalis. Those that arise in the cervical canal become elongated and project from the canal. They usually have long, narrow pedicles. Those which take origin from the portio are more apt to be sessile with a rather broad base.

Histologically they present the glandular epithelium of the cervical canal; cystic and inflammatory changes are frequent. Should the cervical polyp, however, be in contact with the vaginal structures for any length of time it is not unusual to see a superficial zone of squamous epithelial proliferation. This may be either the result of implantation from the vagina or of a metaplasia of the cells. It is rare for cervical polypi to undergo malignant change; in spite of this fact, it is essential to examine all removed polypi histologically, to rule out the presence of cancer.

*Symptoms.* The most frequent symptom is irregular or illegal bleeding. Bleeding following a douche, post-coital spotting and even post-menopausal bleeding can all be caused by a cervical polyp. Occasionally they cause no symptoms.

Clinically they present themselves as bright red, pedunculated growths protruding through the cervical canal. Their pedicle is usually small, long and thin; their body is bulbous

and large, particularly if they are cystic or inflamed. Occasionally they may present themselves at the vulva.

*Treatment.* Surgical removal with a tonsil snare introduced over the pedicle of the polyp to its base is the recommended treatment. The base of the pedicle should then be cauterized. In the office the average polyp can be removed by grasping it close to its base with a sponge forceps (ovum forceps), and twisting it off its attachment. This is painless and usually causes only slight bleeding. The base of the pedicle can then be cauterized.

## OFFICE UROLOGY

A knowledge of kidney, bladder and urethral pathology is an essential part of the training of a gynecologist. The use of the cystoscope for bladder examination and the urethroscope for the direct examination of the urethra should be carried out much more frequently. Cleanliness plus gentleness cannot be overemphasized in this procedure.

*Urethral stricture*, post-gonorrheal strictures, when present can be demonstrated by the urethroscope and should be treated by gradual dilatation, using sounds or bougies. The female urethra under ordinary conditions need not be dilated to more than a No. 30 F.

*Urethral Caruncles.* These consist of small pedunculated or sessile, bright red growths projecting from the urethra. They are usually found along the inferior border of the urethra. Histologically the tumor consists of connective tissue surrounding many large blood vessels, covered by stratified squamous epithelium. Frequently in multiparae a prolapse of the urethral mucous membrane may occur, forming a bright red area immediately surrounding the meatus, which bleeds readily but is usually not as tender as a caruncle.

*Symptomatology.* Pain may or may not be present; when present, it may be very acute. Frequency and burning on urination are usually present.

*Treatment.* The same type of treatment can be used for urethral caruncle and urethral prolapse. The local application

of silver nitrate and other drugs is only of palliative value and does not cure. Some form of surgery must be used.

Anesthesia. The topical application of 10 per cent cocaine to the urethra and surrounding vestibule plus 10 per cent cocaine on an applicator in the urethra produces a good anesthesia.

Simple excision with suture apparently does not cure as recurrences are frequent. The caruncle or prolapsed mucous membrane should be destroyed by radial application of the nasal tip cautery or by the use of the coagulation (bipolar) current. Care should be taken not to cauterize or coagulate the entire circumference of the meatus, as a stricture will result. Always coagulate or cauterize radially, leaving healthy tissue between each streak. Do not use the cautery too hot (too red) as this will produce primary and frequently secondary hemorrhages; the cautery should always be at a cherry red heat. Do not cauterize more often than once every six weeks, allowing sufficient time between treatments for complete healing to occur.

Radium. This is mentioned only to be condemned. Cases where radium has been used have been followed by severe pain, dysuria and urethral stricture worse than the original condition.

*Caution: Owing to the occasional occurrence of carcinoma in this area all tissue removed should be examined microscopically.*

*Trigonitis.* The trigone is a triangular area in the bladder having its apex at the urethra and its base at the two ureteral orifices. The trigone has an entirely different appearance from that of the rest of the bladder. Its vessels and musculature spread fanwise from the urethra towards the two ureteral orifices.

Trigonitis consists of a congestion or inflammation of this area associated with an absence of infection or pus in the urine. The patients present themselves complaining of frequency of urination and a feeling of weight in the pelvis. This is usually secondary to some other pelvic pathology, which must be sought for; however, the trigonitis produces the symptoms of

bladder irritability and frequency for which the patient comes for relief. Simple bladder cystoscopy will verify the diagnosis; it shows a congested trigone with a fairly normal bladder.

Treatment consists in the use of the Dickinson two-way catheter. (Fig. 188.) Through the upper portion of the catheter the bulb is filled with the drug to be used, the catheter is introduced, the retained urine flows out through the lower portion of the catheter, following which the medication is introduced directly on the trigone. The drugs usually used are argyrol 10 per cent, one-half ounce or protargol 2 to 5 per cent, one-half ounce.

*Cystitis.* This can be differentiated from simple trigonitis by the presence of an infected urine. No attempt will be made to describe the various methods of treating cystitis. There is one office treatment, however, which should be emphasized and that is the use of Elliott's treatment (page 362) for thirty minutes daily. This seems to have an almost specific effect in the control of the severe tenesmus, frequency and bearing down feeling of which these patients complain.

*Dribbling of Urine.* Patients frequently complain of dribbling of urine following urination and an inability to hold the urine on coughing, laughing or sneezing. As a rule, if this condition is very marked and it is accompanied by cystocele, urethrocele or other pathology, surgery is indicated. However, there are many patients who do not wish to resort to surgery; these patients can sometimes be relieved by dilatation of the urethra either by the use of gradually increasing size of sounds or the introduction of a Kollmann dilator which can be regulated so as to dilate the urethral sphincter as much as desired. It is advisable not to dilate the urethra beyond 35 F. as a complete paralysis may result. If the urethra is dilated to the point of discomfort, this is usually sufficient. This treatment should be carried out about twice a week for one month. These patients frequently have a complicating trigonitis which should also be treated at the same sitting.

[*The End*]

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